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Arrhythmias developing after Transcatheter Atrial Septal Defect closure: Single-center follow-up results

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Abstract

Objective: Atrial Septal Defect (ASD), one of the most common congenital heart diseases, is usually asymptomatic in childhood, but is associated with long-term consequences such as arrhythmia, stroke, heart failure and pulmonary hypertension. In our study, we aimed to present our experiences in our center and provide information about the arrhythmias we encountered after transcatheter ASD closure, possible risk factors and their course.

Methods: In our study, the files of patients who underwent transcatheter ASD closure in our clinic between 2010 and 2020 were retrospectively scanned. It is a cross-sectional descriptive study. A total of 216 patients were included in our study (131 girls 60.6%, 85 boys 39.4%).. Since our study aimed to detect arrhythmias that developed after ASD closure, even though the follow-up period was long the data especially in the first 6 months after the procedure were evaluated. These evaluated data are: ECG findings, complaints expressed by the patients, if any, and 24-hour rhythm Holter results deemed necessary accordingly.

Results: 216 patients (131 girls 60.6%, 85 boys 39.4%) whose data could be accessed in their files were included in our study. The mean age of the patients was 79±48.5 months (min 30 months, max:17 years). The average ASD size of the patients was 14.27±3.85 mm (min: 9 mm, max:26 mm) and the mean device size was 16.8±3.7 mm (min: 10mm, max: 28 mm). All the patients were at sinus rhythm prior to procedure. Arrhythmia was detected in 13 of the 216 patients included in the study after the closure procedure. The arrhythmia rate after closure was 6%. Of the 13 patients with arrhythmia, supraventricular premature beat (SVE) was detected in 6, ventricular premature beat (VES) in 2, supraventricular tachycardia (SVT) in 2 patients, 1st degree AV block in 1 patient, 2nd degree AV block in 1 patient and 3rd degree AV block in 1 patient.

Conclusions: Arrhythmias that develop after transcatheter treatment are not common and are usually temporary. The best option is to evaluate each patient individually and decide on closure at the most appropriate age possible.

Keywords ASD, arrhythmia, transcatheter closure

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Objective

Atrial Septal Defect (ASD), one of the most common congenital heart diseases, is usually asymptomatic in childhood but, is associated with long-term consequences such as arrhythmia, stroke, heart failure and pulmonary hypertension(1). In childhood, secundum-type ASDs can be closed surgically or, in appropriate cases, safely via a transcatheter. Although transcatheter ASD closure was first applied approximately 5 decades ago, it began to be performed widely, especially after the 2000s. The most commonly used device today is the Amplatzer septal occluder (ASO) (2,3). While ASD itself can cause arrhythmia, especially atrial tachyarrhythmias, there are also cases of arrhythmia reported after ASD closure in the literature (4).

In our study, we aimed to present our experiences in our center and provide information about the arrhythmias we encountered after transcatheter ASD closure, possible risk factors, and their course.

Material and Methods

In our study, the files of patients who underwent transcatheter ASD closure in our clinic between 2010 and 2020 were retrospectively scanned. It is a cross-sectional descriptive study. The total number of patient files processed between these dates was 287. However, 71 patients whose data such as electrocardiography (ECG) and 24-h rhythm Holter recording could not be accessed in their files and patients with additional cardiac anomalies and arrhythmias such as supraventricular premature beats (SVE) or ventricular premature beats (VES) on the ECG before the procedure were excluded from the study. As a result, 216 patients were included in our study (131 girls 60.6%, 85 boys 39.4%). ASD transcatheter closure started in our clinic in the 90s and continued to be applied more widely in the 2000s. Patients who had closure with the Amplatzer septal occluder (ASO) and similar devices (Occlutech septal occluder, Cera occluder) were included in this study. In our clinic, the size of the device to be applied is determined by applying a sizing balloon during the ASD closure procedure. After the device of the appropriate size is determined and the procedure is completed, the patients are hospitalized in the ward and monitored for 2 days, then checked with echocardiography and discharged. Following discharge, echocardiography and ECG were performed at the 1st week, 1st month and 6th month. Thereafter, it is monitored regularly every 6 months. In routine follow-up after ASD closure, we perform annual 24-h rhythm Holter monitoring, but patients with arrhythmia detected on ECG or who have complaints are also given Holter in the first 6 months or at any time. Because our study aimed to detect arrhythmias that developed after ASD closure, even though the follow-up period was long, the data, especially in the first 6 months after the procedure, were evaluated. These evaluated data are: ECG findings, complaints expressed by the patients, if any, and 24-hrhythm Holter results deemed necessary accordingly.

Statistical Analysis

The data were analyzed using SPSS (Statistical Package for Social Sciences) Windows 26.0 software. Kolmogorov-Smirnov test was used to evaluate the suitability of the data for normal distribution. Normally distributed continuous variables are expressed as mean ± standard deviation (SD). Categorical data are reported as frequency (n) and percentage (%). In comparing the differences between the groups, the independent groups t-test was used for normally distributed data and Mann–Whitney U test was used for non-normally distributed data.

Results

A total of 216 patients (131 girls 60.6%, 85 boys 39.4%) whose data could be accessed in their files were included in our study. The mean age of the patients was 79±48.5 months (min 30 months, max:17 years). The average ASD size of the patients was 14.27±3.85 mm (min: 9 mm, max:26 mm) and the mean device size was 16.8±3.7 mm (min: 10mm, max: 28 mm). All the patients were at sinus rhythm before the procedure. The ECG of 9 patients showed an incomplete right bundle branch block, and 3 patients had a complete right bundle branch block. No major complications occurred during the closure procedure. After closure, the mean follow-up period was 3.2±1.8 years (range 9 months-7.5years). Arrhythmia was detected in 13 of the 216 patients included in the study after the closure procedure.

Table 1. Patient data

Number of Patients	216 (131 girl, 85 boy)
Age	79±48.5 months
Defect size	14.27±3.85 mm
Device size	16.8±3.7 mm
Devices	Amplatzer septal occluder :145(n) Occlutech septal occluder: 62 (n) Cera occluder: 9(n)
Follow-up period	3.2±1.8 years (range 9 months-7.5years)

The arrhythmia rate after closure was 6%. Of the 13 patients with arrhythmia, supraventricular premature beat (SVE) was detected in 6, ventricular premature beat (VES) in 2, supraventricular tachycardia (SVT) in 2 patients, 1st degree AV block in 1 patient, 2nd degree AV block in 1 patient and 3rd degree AV block in 1 patient.

All 6 patients in whom we detected SVE were asymptomatic, and SVE was detected with the ECG taken during routine outpatient clinic follow-ups. The time to detect SVE was 1 month after the procedure. SVE was also present in the 24-h rhythm Holters. Couplet, triplet, and SVT were not detected. During the follow-up of these patients, whom we followed without medication, SVE resolved spontaneously within 1 year in 5 of our patients. One patient whose SVE persisted was asymptomatic and continued to be monitored without medication. Both of our 2 patients who developed VES were detected during their routine check-ups 1 month after the procedure. These asymptomatic patients, whose 24-h rhythm Holter tests showed no pathological findings other than rare VES, were followed up without medical treatment. VES was not detected at the 6-month follow-up and then after.

The first of our 2 patients with SVT had SVT immediately after the device was implanted during the procedure. SVT lasted for about 30 s and ended spontaneously. Our second SVT patient came to the outpatient clinic with a complaint of palpitations 1 month after the procedure. Although the ECG was in sinus rhythm, SVT was detected in the 24-h rhythm Holter. Beta blocker treatment was started in this patient. SVT did not recur during the follow-up visits after treatment. After 1 year of medication use, the patient was asymptomatic and no SVT was observed on Holter, and treatment was discontinued. The patient remained asymptomatic and in sinus rhythm at the next follow-up visit.

We had 3 cases with different degrees of block. In 1 patient, a complete block developed while the device was being placed during the procedure. However, the block was short-lived and spontaneously returned to the sinus rhythm. The procedure was continued and the device was placed, and no problems occurred afterwards. No rhythm problem did not recur during the follow-up of the patient.

In the other 2 patients who developed block, AV block was detected in the ECG taken before discharge from the service after the procedure. It was observed that one patient developed 1st-degree AV block and the other patient developed 2nd-degree AV block. Both patients were asymptomatic. While the 1st-degree AV block continued, the patient developed Mobitz Type 1 2nd-degree AV block, and no block was observed at the 1st month follow-up.

In our study, among the patients with arrhythmia, there were only 2 patients with a device diameter larger than 19 mm and those patients had SVE. Furthermore, the procedure time of patients with SVE was not longer than that of other patients without arrhythmia.

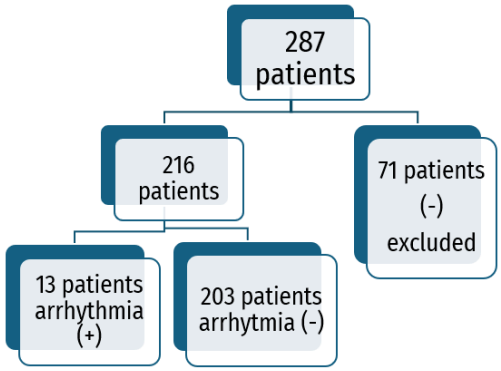

Figure 1. Distribution of patients

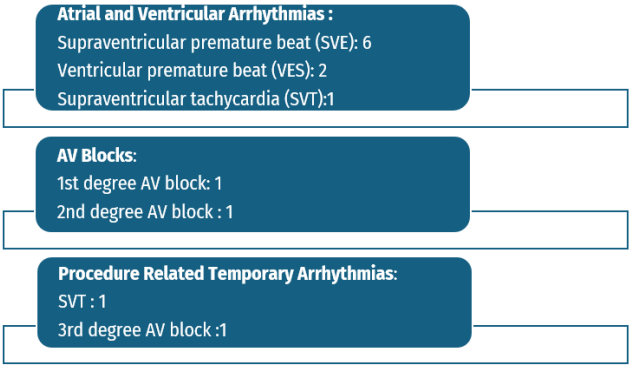

Figure 2. Distribution of patients with arrhythmia (n)

Discussion

The relationship between ASD and arrhythmia is well known and the mechanisms are clearly defined. It is also clearly known that the risk of arrhythmia increases with increasing age. It has been stated in studies in the literature that there is a high risk of arrhythmia, especially in patients over the age of 40 who undergo ASD closure (5). As markers of arrhythmia risk: ASD diameter, presence of comorbidities and most importantly, age of ASD closure. Therefore, although ASD is closely related to arrhythmias such as atrial fibrillation (AF) in the adult patient group, AF is very rare in childhood (6,7). In our study, unlike studies conducted in adults, AF was not observed in any patient.

In studies conducted on pediatric patients, it has been stated that children who had arrhythmia before the procedure have a higher risk of developing arrhythmia after the procedure, and the risk is especially increased in those with a device size larger than 19 mm (8).

In a study, 24-h rhythm Holter evaluation was performed before and after transcatheter ASD closure and they showed that there was a significant increase in the frequency of supraventricular tachyarrhythmia. However, no increase in the frequency of VES was detected (9). The increase

in tachyarrhythmia frequency may be due entirely to the procedure. It has been stated in some articles that there is a direct proportion between the frequency of SVE detected in the first month after the procedure and the duration of the procedure (10).

Arrhythmias that develop after ASD closure are mostly temporary and return to sinus rhythm spontaneously within 1 year (11-15). Consistent with the literature, in our study, among the patients with SVE and SVT, SVE continued after 1 year in only one patient, and all the remaining patients resolved spontaneously within 6-12 months. This patient was asymptomatic and was monitored without medication and, continued this way throughout the follow-up. In addition, 1 patient who had SVT and was given medical treatment recovered within 1 year.

In the literature, rhythm disorders such as sinus bradycardia and AV block are also mentioned as conditions encountered after transcatheter ASD closure (6).In our own clinical experience, we have encountered varying degrees of AV block during and after closure. However, we did not have any patients with sinus bradycardia.

As it is known that the frequency of arrhythmias increases when ASD is closed, especially after the age of 40, it is also very important that arrhythmias such as AF that occur in this period show persistent characteristics (5). Recent studies on the relationship between ASD and arrhythmia show that the frequency of adult arrhythmia in those with ASD closure age of 21 and below is the same as that in the normal population (4). This is valid if transcatheter treatment is used as a closure method, and it has been shown that the risk of late arrhythmia is high in cases where surgical closure is performed, even if the procedure is performed before the age of 21 years, and the presence of a surgical scar alone is shown as the reason for this. Therefore, transcatheter treatment may be a better method compared to surgery because it has less risk of arrhythmia in the long term(16).

Transcatheter treatment of ASD is a safe method with few complications, as stated in many publications in the literature, and arrhythmias due to the procedure itself are infrequent and tend to resolve spontaneously (17-21). The cases of SVT and complete AV block that developed during the procedure we presented in our study were temporary, but since there are articles in the literature that evaluate the temporary rhythm disorders that develop in relation to this procedure and recommend procedural techniques and arrhythmia treatment, we also described these cases (22).Therefore, ASD closure is recommended in cases with enlargement of the right heart chambers, regardless of the Qp/Qs ratio, to prevent late complications such as permanent arrhythmia (15).

Conclusions

ASD itself is associated with significant and persistent long-term arrhythmia problems. The closure process may also cause some rhythm problems in patients without arrhythmia before. However, arrhythmias that develop after transcatheter treatment are not common and are usually temporary. The best option is to evaluate each patient individually and decide on closure at the most appropriate age possible.

Ethics Committee Approval	This study was approved by Istanbul University, Clinical Research Ethics Committee (18/10/2024 - 20)
Informed Consent	Serra Karaca
Peer Review	Externally peer-reviewed.
Author Contributions	Conception/Design of Study-; Data Acquisition-; Data Analysis/Interpretation-; Drafting Manuscript-; Critical Revision of Manuscript-; Final Approval and Accountability-
Conflict of Interest	Authors declared no conflict of interest.
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