Effectiveness and Safety of Management Strategies for Cardiac Arrhythmias in Pregnancy: A Prospective Observational Study

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Abstract

Introduction: Cardiac arrhythmias during pregnancy pose significant risks to both maternal and fetal health, necessitating careful diagnostic and therapeutic strategies.

Objective: To prospectively evaluate the management strategies and clinical outcomes of cardiac arrhythmias in pregnant women, focusing on the safety, effectiveness, and maternal-fetal implications of both pharmacologic and non-pharmacologic interventions.

Methodology: A prospective observational study was conducted at the Department of Cardiology, Punjab Institute of Cardiology, Lahore, from July 2023 to June 2024. A total of 228 pregnant women diagnosed with cardiac arrhythmias were enrolled based on predefined inclusion criteria. Data were collected on demographics, arrhythmia type, diagnostic findings, management approaches, and maternal and fetal outcomes. Statistical analysis included Chi-square and t-tests with $p < 0.05$ considered significant.

Results: Supraventricular tachycardia (SVT) was the most common arrhythmia, affecting 89 patients (39.04%), followed by premature atrial contractions in 42 patients (18.42%) and atrial fibrillation in 27 patients (11.84%). Pharmacologic therapy was used in 165 patients (72.37%), primarily beta-blockers in 102 patients (44.74%), while 63 patients (27.63%) received non-pharmacologic treatments. Significant associations were found between management type and arrhythmia control ($\chi^2 = 9.82$; $p = 0.043$), and QT prolongation and recurrent episodes ($\chi^2 = 8.12$; $p = 0.017$). Favorable maternal outcomes were observed, with 174 patients (76.32%) achieving full arrhythmia control and no maternal deaths (0%). Fetal outcomes were largely positive, with 183 neonates (80.26%) having normal birth weight and 169 deliveries (74.12%) occurring at term.

Conclusion: Cardiac arrhythmias during pregnancy were effectively managed with individualized pharmacologic and non-pharmacologic strategies. Early identification of risk factors like QT prolongation and interdisciplinary care are critical. Further multicenter studies with longer postpartum follow-up are warranted to assess long-term outcomes of both mothers and infants.

Keywords: Cardiac arrhythmia, pregnancy, supraventricular tachycardia, fetal outcomes, beta-blockers, prospective study

Introduction

Cardiac arrhythmias during pregnancy are a difficult clinical problem because of the changes in the cardiovascular system that happen during pregnancy and the possible effects on the health of both the mother and the baby [1,2]. Changes in blood flow during pregnancy, such as an increase in blood volume, cardiac output, and hormone levels, might make existing arrhythmias worse or reveal hidden conduction

problems [3]. These problems with rhythm may be as simple as early contractions of the atria or ventricles that aren't harmful, or they can be more problematic, such supraventricular tachycardia (SVT), atrial fibrillation, or ventricular arrhythmias [4]. Some arrhythmias are not a big deal, but others may cause serious health problems including syncope, heart failure, thromboembolism, or sudden cardiac death [5].

Even though arrhythmias are not very prevalent during pregnancy, they are hard to treat since you have to weigh the advantages to the mother against the risks to the fetus [6,7]. Many antiarrhythmic drugs may enter the placenta and may induce birth defects or fetal arrhythmias, particularly in the first trimester [8,9]. Also, people frequently don't want to have invasive diagnostic or therapeutic treatments like catheter ablation or cardioversion because they are worried about radiation exposure or the hazards of the surgery [10]. Because of these factors, diagnosis and therapy must be done carefully and for each person, which frequently means that cardiologists, obstetricians, and anesthesiologists need to work together [11].

There isn't a lot of research on arrhythmias during pregnancy; much of the information comes from case reports or studies that go back in time. There aren't enough prospective studies yet that look at standardized management techniques and their results. Also, the many ways that arrhythmias might show up, the different underlying heart problems, and the different kinds of arrhythmias make it much harder to make decisions and add to the lack of agreement on the best ways to treat them. Because there is a chance of difficulties for both the mother and the baby and because arrhythmia treatment is always changing, it is important to come up with evidence-based ways to keep the mother's heart stable while lowering the danger to the baby.

Research Objective
To prospectively evaluate the management strategies and clinical outcomes of cardiac arrhythmias in pregnant women, focusing on the safety, effectiveness, and maternal-fetal implications of both pharmacologic and non-pharmacologic interventions.

Materials and Methods
Study Design and Setting
This prospective observational study was conducted at the Department of Cardiology, Punjab Institute of Cardiology, Lahore, over a one-year period from July 2023 to June 2024.

Inclusion and Exclusion Criteria
We included pregnant women of any gestational age who had heart arrhythmias that were either already there or acquired during pregnancy. Clinical evaluation and conventional electrocardiographic results revealed that the patient had arrhythmias. Women with structural heart disease that needed surgery to fix it, congenital heart problems, patients whose blood flow was unstable and needed emergency care outside of the study's scope,

and those who refused or couldn't provide informed permission were not included.

Sample Size
The study included 228 pregnant women who had been diagnosed with arrhythmias and other heart problems. Participants were chosen via convenient sampling, which made sure that they met certain eligibility requirements and were available throughout the research time. Using established statistical techniques, we figured out how many people we needed to sample to be 95% sure that the results were correct, with a 5% margin of error. We assumed that 20% of pregnant women would have arrhythmias. This sample size is big enough to provide reliable results and useful information on how to treat and deal with arrhythmias during pregnancy.

Data Collection
Detailed demographic information, obstetric and medical history, arrhythmia type, electrocardiographic findings, and echocardiographic evaluations were recorded at baseline. There were two types of management approaches: pharmaceutical (such as beta-blockers, calcium channel blockers, and antiarrhythmics) and non-pharmacologic (such as vagal maneuvers and electrical cardioversion). Monitoring patients throughout their pregnancies recorded clinical outcomes such as arrhythmia management, maternal problems (including syncope and heart failure), and fetal measures like birth weight, Apgar score, and gestational age at delivery.

Statistical Analysis
Data were analyzed using SPSS version 26.0. Continuous variables were expressed as mean ± standard deviation (SD), and categorical variables as frequencies and percentages. The Chi-square test was used for categorical comparisons, and the t-test for continuous variables. A p-value < 0.05 was considered statistically significant.

Ethical Approval
Ethical clearance for the study was obtained from the Institutional Review Board (IRB) of Punjab Institute of Cardiology, Lahore, under approval number 274-2023/DC/PIC. Written informed consent was obtained from all participants prior to enrollment.

Results
Out of 228 pregnant women, 72 (31.58%) were aged 26–30 years, followed by 61 (26.75%) aged 31–35 years, 54 (23.68%) aged 18–25 years, and 41 (17.98%) over 35 years (table 1). While 39 (17.11%) presented in the first trimester, 86 (37.72%) did so in the third, and the majority (103; 45.18%) did so in the second. Primigravidas made up 92 (40.35%) of the sample, whilst multigravidas made up 136 (59.65%). Of those with comorbidities, 130 (57.02%) had no comorbidity, 48 (21.05%) had hypertension, 31 (13.60%) had diabetes mellitus, and 19 (8.33%) had thyroid diseases.

Table 1: Baseline Demographic and Obstetric Characteristics (N = 228)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	18−25	54	23.68
	26−30	72	31.58
	31−35	61	26.75
	>35	41	17.98
Gestational Age at Presentation	First Trimester	39	17.11
	Second Trimester	103	45.18
	Third Trimester	86	37.72
Gravida	Primigravida	92	40.35
	Multigravida	136	59.65
Comorbid Conditions	Hypertension	48	21.05
	Diabetes Mellitus	31	13.60
	Thyroid Disorders	19	8.33
	No Comorbidity	130	57.02

The most common arrhythmia among the 228 patients was supraventricular tachycardia (SVT), which was identified in 89 women (39.04%), figure 1. Forty-two (18.42%) had premature atrial contractions (PACs), while thirty-five (15.35%) experienced premature ventricular contractions (PVCs). Twenty-seven (11.84%) had atrial fibrillation (AF), fifteen (6.58%) had ventricular tachycardia (VT), thirteen (5.70%) had atrial flutter, and seven (3.07%) had other arrhythmias such AV nodal re-entry.
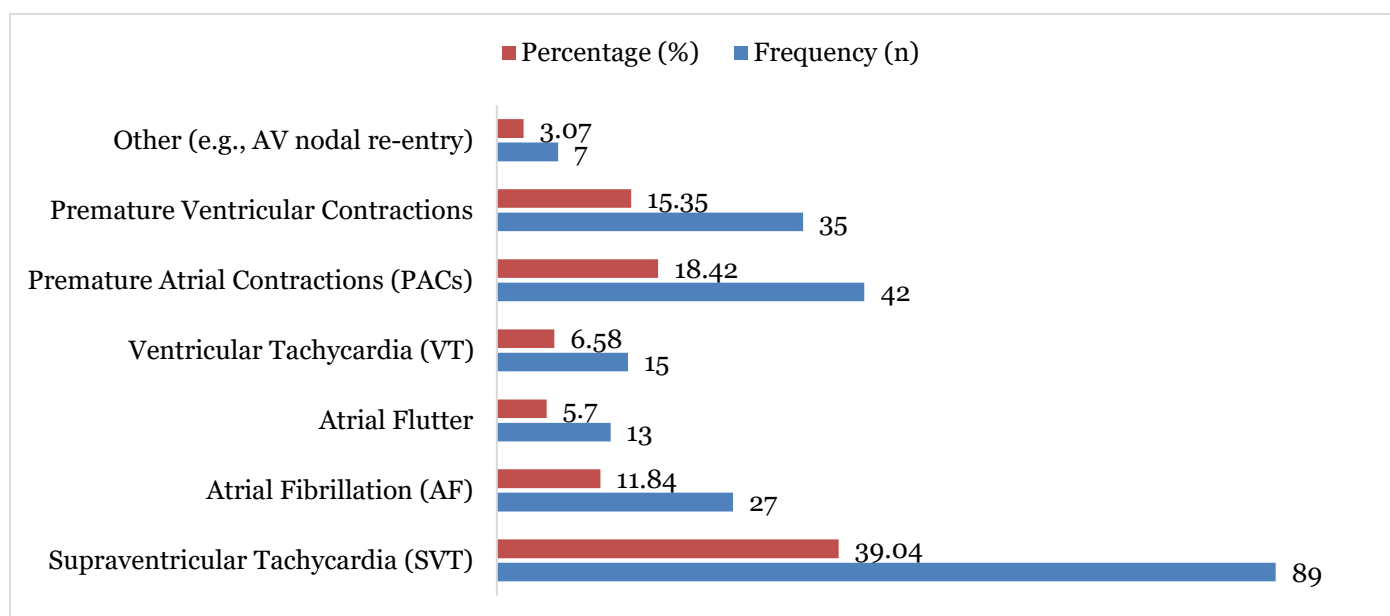

Figure 1: Types of Cardiac Arrhythmias Diagnosed

While 69 women (30.26%) had normal ECGs, a significant proportion—159 women (69.74%)—presented with abnormal findings, highlighting the importance of routine electrocardiographic evaluation in women with suspected arrhythmias (Figure 2).

Among these abnormalities, QT interval prolongation was identified in 28 cases (12.28%), a clinically relevant finding given its association with increased risk of ventricular arrhythmias. Echocardiographic assessment revealed that the majority of patients—217 (95.18%)—maintained intact systolic function. However, structural heart disease was observed in 36 women (15.79%), while 17 (7.46%) exhibited left ventricular diastolic dysfunction. A reduced ejection fraction (<50%) was seen in 11 cases (4.82%), warranting closer follow-up due to the increased risk of adverse cardiac outcomes.

Pharmacologic therapy was administered to 165 out of 228 patients (72.37%), indicating a strong reliance on medical management for arrhythmia control (Table 2). Beta-blockers were the most commonly prescribed agents (102 patients, 44.74%), reflecting their efficacy and safety profile in rate and rhythm control. Calcium channel blockers were used in 33 cases (14.47%), while Class I/III antiarrhythmics were prescribed in 19 patients (8.33%)—typically reserved for those with refractory or more complex arrhythmias. Digoxin was used in 11 cases (4.82%), primarily for rate control in atrial fibrillation. Non-pharmacologic management strategies were used in 63 women (27.63%), including vagal maneuvers in 41 (17.98%)—often effective in terminating supraventricular tachycardias—electrical cardioversion in 13 (5.70%) for more unstable or persistent cases, and observation without intervention in 9 women (3.95%), typically in self-limiting or asymptomatic episodes.
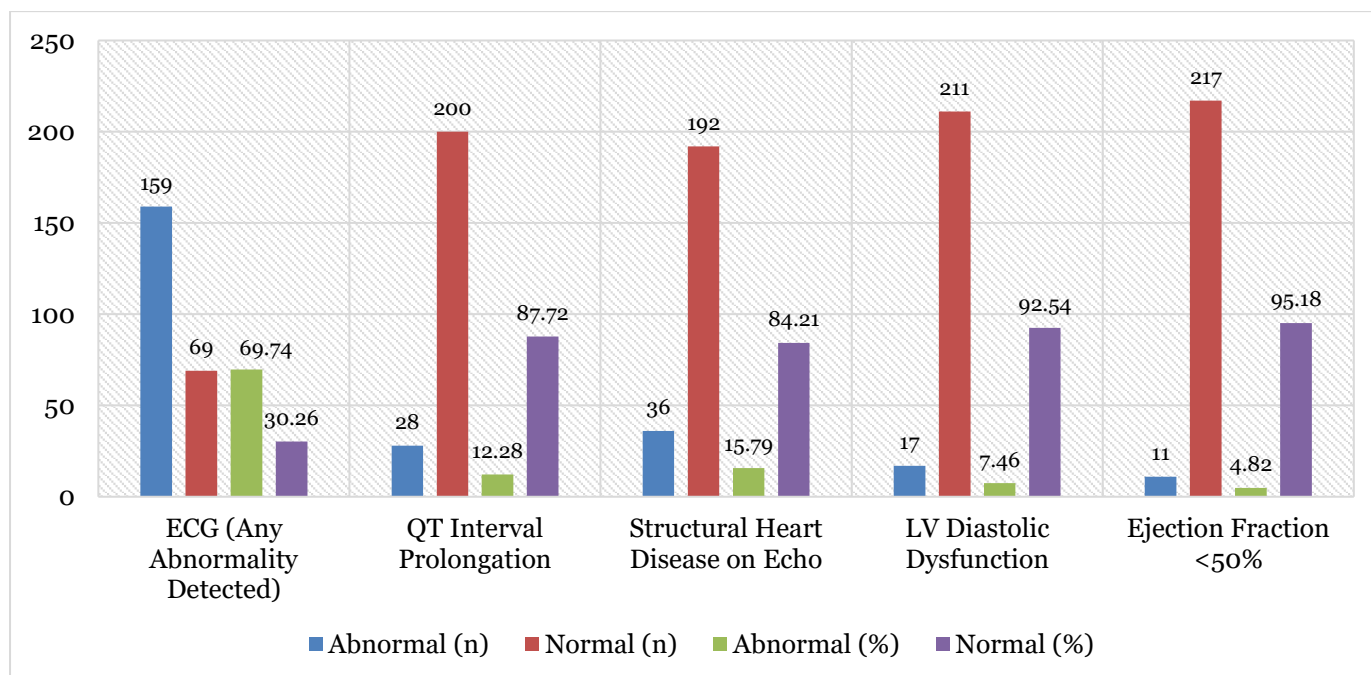
Figure 2: Electrocardiographic (ECG) and Echocardiographic Findings

Table 2: Management Approaches Used (N = 228)

Category	Management Modality	Frequency (n)	Percentage (%)
Pharmacologic	Beta-Blockers	102	44.74
	Calcium Channel Blockers	33	14.47
	Class I/III Antiarrhythmics	19	8.33
	Digoxin	11	4.82
Non-Pharmacologic	Vagal Maneuvers	41	17.98
	Electrical Cardioversion	13	5.70
	Observation (No active intervention)	9	3.95

As shown in Figure 3, 174 of the 228 women (76.32%) achieved complete control of their arrhythmias during the study period, suggesting a generally favorable response to treatment. Moderate control was observed in 42 cases (18.42%), while 12 women (5.26%) continued to experience recurrent arrhythmic episodes despite intervention. Regarding clinical outcomes, 9 patients (3.95%) developed heart failure, 16 (7.02%) experienced syncope—raising concerns about arrhythmia-related cerebral hypoperfusion—and 21 (9.21%) required hospitalization for cardiac reasons. Importantly, there were no maternal deaths (0%) during the study period, indicating that, despite the frequency and variety of arrhythmias observed, overall maternal prognosis remained favorable with appropriate management.
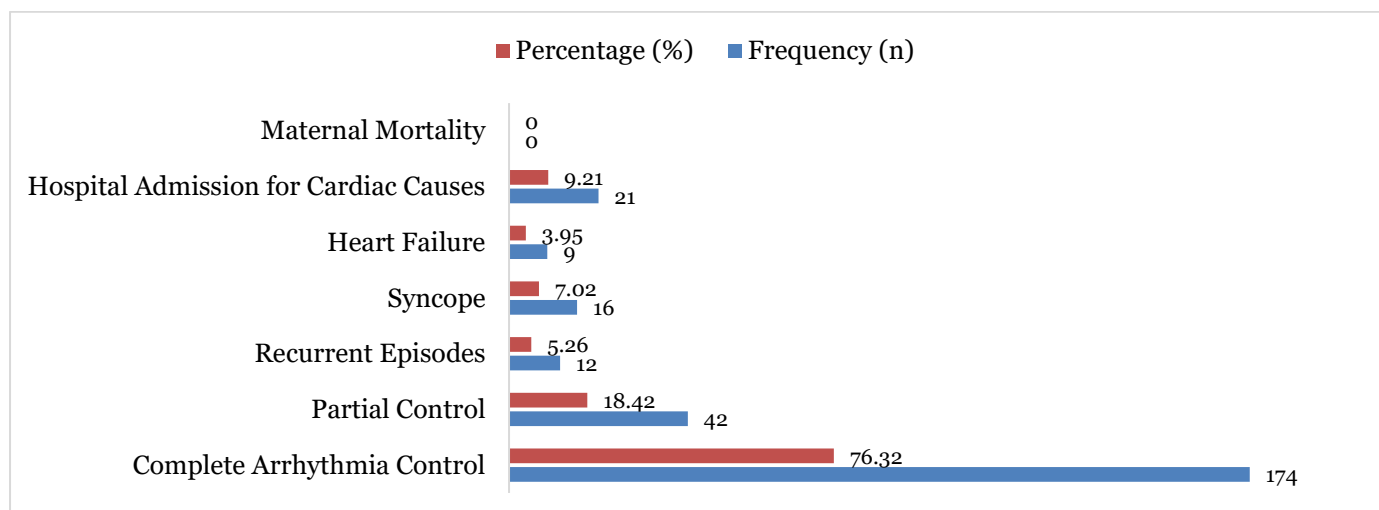

Figure 3: Maternal Clinical Outcomes during Pregnancy

Normal birth weight (>2.5 kg) was recorded in 183 (80.26%) neonates, while 45 (19.74%) had low birth weight (figure 4). Term delivery occurred in 169 (74.12%) pregnancies, with 59 (25.88%) preterm births. A favorable Apgar score (≥7 at 1 minute) was noted in 204 (89.47%) newborns, while 24 (10.53%) had lower scores. NICU admission was required for 19 (8.33%) neonates, and fetal mortality was reported in 2 cases (0.88%).
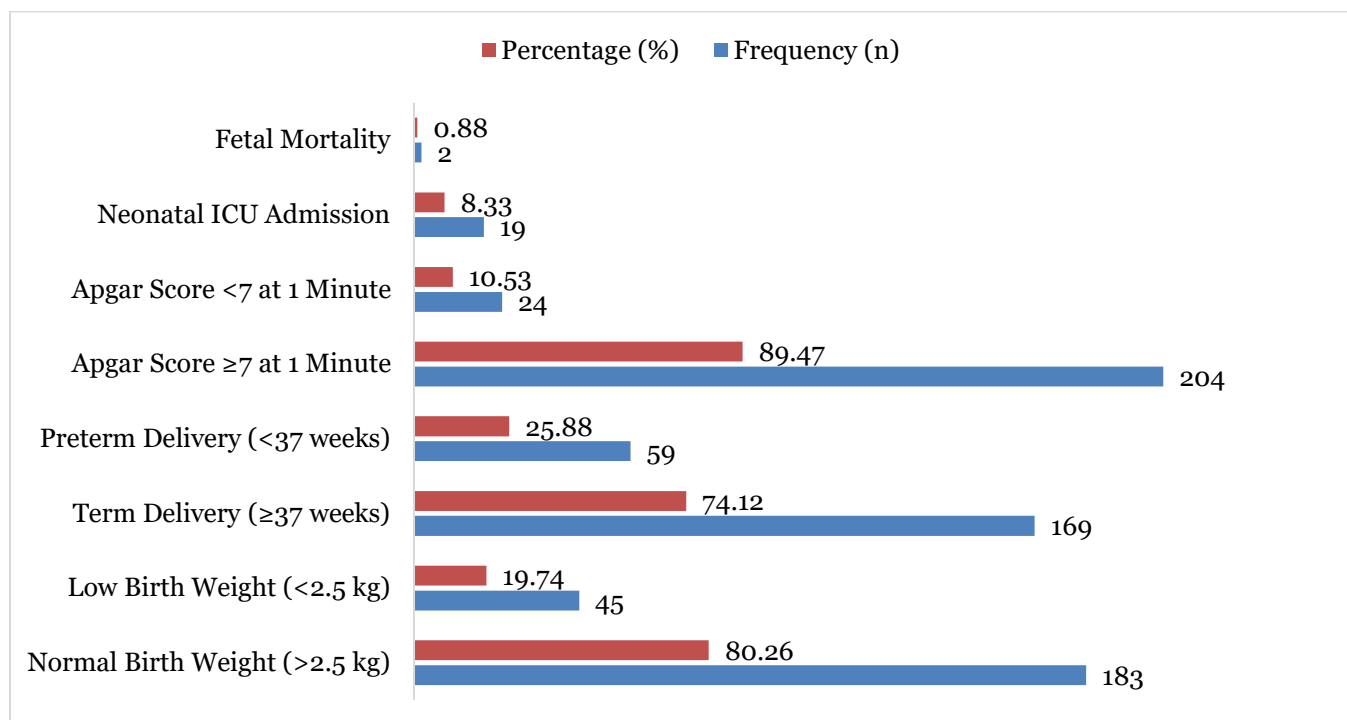

Figure 4: Fetal Outcomes

Chi-square testing revealed significant associations: arrhythmia control differed by management type (χ^2 = 9.82; p = 0.043), and hospital admissions varied by arrhythmia type (χ^2 = 11.67; p = 0.031). Pharmacologic use was associated with preterm delivery (χ^2 = 4.23; p = 0.040), and QT prolongation significantly predicted recurrent arrhythmias (χ^2 = 8.12; p = 0.017). Trends were noted between management type and maternal complications (p = 0.059), and arrhythmia type and NICU admission (p = 0.076), as shown in table 3.

Table 3: Association between Management Strategies and Clinical Outcomes (Chi-square Analysis)

Comparison	Categories Compared	Chi-square	p-value
Management Type vs. Arrhythmia Control	Pharmacologic vs. Non-Pharmacologic vs. Observation	9.82	0.043
Arrhythmia Type vs. Hospital Admission	SVT / AF / VT / Others	11.67	0.031
Management Type vs. Maternal Complications (Syncope, HF)	Beta-blockers / CCBs / Others	7.45	0.059
Pharmacologic Use vs. Preterm Delivery	Yes vs. No	4.23	0.040
Arrhythmia Type vs. NICU Admission	SVT / VT / AF / PACs / PVCs	6.89	0.076
QT Prolongation vs. Recurrent Episodes	Present vs. Absent	8.12	0.017

Women with recurrent arrhythmias had higher mean maternal age (30.8 ± 5.1 years) compared to those with controlled arrhythmias (28.9 ± 4.7 years; p = 0.021), and lower gestational age at delivery (36.6 ± 2.2 weeks vs. 38.1 ± 1.4; p < 0.001), shown in table 4. Birth weight was higher in those receiving pharmacologic treatment (2.83 ± 0.46 kg vs. 2.65 ± 0.51 kg; p = 0.031). Women with heart failure had significantly lower ejection fraction (48.3 ± 3.1% vs. 56.2 ± 4.8%; p < 0.001). Those with maternal complications were older (31.2 ± 5.4 vs. 28.3 ± 4.9 years; p = 0.001).

Table 4: Independent Samples t-Test Results for Continuous Variables

Comparison	Continuous Variable	Grouping Variable	Mean ± SD (Group 1)	Mean ± SD (Group 2)	t-value	p-value
Arrhythmia Controlled vs. Recurrent	Maternal Age (years)	Complete Control vs. Recurrent	28.9 ± 4.7	30.8 ± 5.1	2.34	0.021
	Gestational Age at Delivery (weeks)	Control vs. Recurrent	38.1 ± 1.4	36.6 ± 2.2	3.76	<0.001

Pharmacologic vs. Non-Pharmacologic Treatment	Birth Weight (kg)	Pharmacologic vs. Non-Pharmacologic	2.83 ± 0.46	2.65 ± 0.51	2.18	0.031
Heart Failure Present vs. Absent	Ejection Fraction (%)	HF vs. No HF	48.3 ± 3.1	56.2 ± 4.8	6.59	<0.001
Maternal Complications (Yes/No)	Maternal Age (years)	Yes vs. No	31.2 ± 5.4	28.3 ± 4.9	3.22	0.001

Discussion

Cardiac arrhythmias during pregnancy, although relatively uncommon, can pose serious maternal and fetal risks. In our research of 228 pregnant women, SVT was the most common arrhythmia, involving 89 patients (39.04%). This was followed by premature atrial contractions (42 patients; 18.42%) and atrial fibrillation (27 patients; 11.84%). These results are in line with those of a recent research that found SVT to be the most common rhythm problem in pregnant women, especially those who did not have structural heart disease [12]. Our research found that only 15 patients (6.58%) had life-threatening arrhythmias including ventricular tachycardia, which is similar to what was found in the Pregnancy and Cardiac Disease Registry [13,14].

One interesting thing we found in our survey was that most patients (165 patients, 72.37%) preferred pharmacologic therapy, especially beta-blockers (102 patients; 44.74%), since they are known to be safe during pregnancy. Previous research supports this strategy, which stressed that beta-blockers should be the first-line treatment for symptomatic SVT in pregnant women [15]. Non-drug techniques, such as vagal maneuvers (41 patients; 17.98%) and electrical cardioversion (13 patients; 5.70%), were only used for quick symptom alleviation or patients that didn't respond to drugs. Our study found a statistically significant link between drug therapy and arrhythmia control (χ^2 = 9.82; p = 0.043), which supports its use as a treatment.

It is important to note that the results for mothers were generally good, with 174 patients (76.32%) having total control of their arrhythmia and no fatalities recorded. But a small group had syncope (16 patients; 7.02%) or cardiac failure (9 patients; 3.95%). Patients who experienced heart failure had a much lower ejection fraction (48.3 ± 3.1%) than those who didn't (56.2 ± 4.8%; p < 0.001). These results are in line with what the previous research found, which said that women with underlying systolic dysfunction and arrhythmia had higher rates of maternal morbidity [16].

In our group, the results for the babies were good: 183 neonates (80.26%) were born with a normal birth weight and 169 (74.12%) were born on time. Still, 19 neonates (8.33%) were admitted to the NICU, and 2 (0.88%) died before birth. A longer QT interval was strongly linked to recurrent arrhythmias (χ^2 = 8.12; p = 0.017), which may indicate that the fetus needs to be watched more closely. Previous studies have also

shown that repolarization abnormalities during pregnancy might cause arrhythmias, which supports our results [17].

These findings support the importance of early screening for QT prolongation during pregnancy to identify women at risk of recurrent arrhythmias. Establishing standardized protocols involving interdisciplinary collaboration among cardiologists, obstetricians, and neonatologists can optimize outcomes for both mother and fetus.

Our results show that antiarrhythmic techniques may be used safely and effectively during pregnancy, but they also stress the need of tailored care to reduce difficulties for both the mother and the baby.

Strength and Limitations of Study
This study's prospective design, which reduced memory bias and improved data reliability by enabling real-time data collecting and careful monitoring of maternal and fetal outcomes, is one of its main strengths. The study's generalizability to comparable clinical settings in South Asia was further enhanced by the inclusion of a rather large and varied sample (n = 228) from a tertiary care facility. Furthermore, the thorough assessment of pharmaceutical and non-pharmacologic therapies provides useful information for interdisciplinary care planning.

A number of limitations should be noted. The study's single-center design could restrict its wider application. Furthermore, postnatal maternal and newborn outcomes were not evaluated since follow-up was restricted to the pregnant period. Lastly, the long-term fetal consequences of antiarrhythmic medications are not addressed, and treatment-selection bias may be introduced by the absence of randomization in management regimens.

Conclusion

This prospective research demonstrates that personalized strategies may successfully control cardiac arrhythmias during pregnancy, with the most often utilized therapies being beta-blockers and vagal maneuvers. Favorable maternal outcomes were observed, with most women achieving total arrhythmia control and no maternal fatalities. Fetal outcomes were generally encouraging, although several risk variables, such as QT prolongation and pharmacologic treatment, were linked to increased risks of preterm births and recurrent arrhythmias, respectively. These results highlight the need for prompt diagnosis, risk

assessment, and interdisciplinary care to maximize the health of both the mother and the fetus in arrhythmia-complicated pregnancies. Further multicenter studies with longer postpartum follow-up are warranted to assess long-term outcomes of both mothers and infants.

Authors' Contributions

References

1. Ramlakhan KP, Johnson MR, Roos-Hesselink JW. Pregnancy and cardiovascular disease. Nature Reviews Cardiology. 2020 Nov;17(11):718-31. https://doi.org/10.1038/s41569-020-0390-z.

2. Gowda RM, Khan IA, Mehta NJ, Vasavada BC, Sacchi TJ. Cardiac arrhythmias in pregnancy: clinical and therapeutic considerations. International journal of cardiology. 2003 Apr 1;88(2-3):129-33. https://doi.org/10.1016/S0167-5273(02)00601-0.

3. Conti E, Cascio ND, Paluan P, Racca G, Longhitano Y, Savioli G, Tesauro M, Leo R, Racca F, Zanza C. Pregnancy arrhythmias: management in the emergency department and critical care. Journal of Clinical Medicine. 2024 Feb 15;13(4):1095. https://doi.org/10.3390/jcm13041095.

4. Fu, Dg. Cardiac Arrhythmias: Diagnosis, Symptoms, and Treatments. Cell Biochem Biophys 73, 291–296 (2015). https://doi.org/10.1007/s12013-015-0626-4

5. John RM, Tedrow UB, Koplan BA, Albert CM, Epstein LM, Sweeney MO, Miller AL, Michaud GF, Stevenson WG. Ventricular arrhythmias and sudden cardiac death. The Lancet. 2012 Oct 27;380(9852):1520-9. DOI: https://doi.org/10.1016/S0140-6736(12)61413-5

6. Gowda RM, Khan IA, Mehta NJ, Vasavada BC, Sacchi TJ. Cardiac arrhythmias in pregnancy: clinical and therapeutic considerations. International journal of cardiology. 2003 Apr 1;88(2-3):129-33. https://doi.org/10.1016/S0167-5273(02)00601-0.

7. Lee JC, Wetzel G, Shannon K. Maternal arrhythmia management during pregnancy in patients with structural heart disease. Progress in Pediatric cardiology. 2004 May 1;19(1):71-82. https://doi.org/10.1016/j.ppedcard.2003.09.002.

8. Fischer AJ, Diller GP, Uebing A, Nürnberg JH, Hebe J. Antiarrhythmic drugs—Safety and efficacy during pregnancy. Herzschrittmachertherapie+ Elektrophysiologie. 2021 Jun;32(2):145-51. https://doi.org/10.1007/s00399-021-00759-2.

9. Kleinman CS, Nehgme RA. Cardiac arrhythmias in the human fetus. Pediatric cardiology. 2004 Jun;25(3):234-51. https://doi.org/10.1007/s00246-003-0589-x.

10. Suzanne Lydiard P, Blanck O, Hugo G, O'Brien R, Keall P. A review of cardiac radioablation (CR) for arrhythmias: procedures, technology, and future opportunities. International Journal of Radiation Oncology Biology Physics. 2021 Mar 1;109(3):783-800. https://doi.org/10.1016/j.ijrobp.2020.10.036.

11. Tamirisa KP, Dye C, Bond RM, Hollier LM, Marinescu K, Vaseghi M, Russo AM, Gulati M, Volgman AS. Arrhythmias and heart failure in pregnancy: a dialogue on multidisciplinary collaboration. Journal of cardiovascular development and disease. 2022 Jun 24;9(7):199. https://doi.org/10.3390/jcdd9070199.

12. Fürniss HE, Stiller B. Arrhythmic risk during pregnancy in patients with congenital heart disease. Herzschrittmachertherapie+ Elektrophysiologie. 2021 Jun;32(2):174-9. https://doi.org/10.1007/s00399-021-00754-7.

13. Sapp JL, Wells GA, Parkash R, Stevenson WG, Blier L, Sarrazin JF, Thibault B, Rivard L, Gula L, Leong-Sit P, Essebag V. Ventricular tachycardia ablation versus escalation of antiarrhythmic drugs. New England Journal of Medicine. 2016 Jul 14;375(2):111-21. DOI: https://doi.org/10.1056/NEJMoa1513614

14. Katritsis DG, Zareba W, Camm AJ. Nonsustained ventricular tachycardia. Journal of the American College of Cardiology. 2012 Nov 13;60(20):1993-2004. http://dx.doi.org/10.1016/j.jacc.2011.12.063.

15. Manolis TA, Manolis AA, Apostolopoulos EJ, Papatheou D, Melita H, Manolis AS. Cardiac arrhythmias in pregnant women: need for mother and offspring protection. Current Medical Research and Opinion. 2020 Jul 2;36(7):1225-43. https://doi.org/10.1080/03007995.2020.1762555

16. Tamirisa KP, Dye C, Bond RM, Hollier LM, Marinescu K, Vaseghi M, Russo AM, Gulati M, Volgman AS. Arrhythmias and heart failure in

pregnancy: a dialogue on multidisciplinary collaboration. Journal of cardiovascular development and disease. 2022 Jun 24;9(7):199. https://doi.org/10.3390/jcdd9070199.

17.   Zhao H, Strasburger JF, Cuneo BF, Wakai RT. Fetal cardiac repolarization abnormalities. The American journal of cardiology. 2006. https://doi.org/10.1016/j.amjcard.2006.03.026.

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