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Research Article

Management and Clinical Outcomes of Cardiac Arrhythmias in Pregnancy: A Prospective Study from Peshawar, Pakistan

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Abstract

Background: Cardiac arrhythmias are common during pregnancy and pose significant risks to both maternal and fetal health, necessitating a thorough understanding of their management and outcomes. **Objective**: This study aimed to evaluate the types, causes, management strategies, and clinical outcomes of arrhythmias in pregnant women to inform better treatment approaches. **Methodology**: A prospective observational study was conducted from January to December 2023. A total of 246 pregnant women diagnosed with arrhythmias were included. We gathered information on demographics, pre-existing diseases, clinical presentations, kinds of arrhythmias, underlying causes, treatment approaches, and outcomes for both the mother and the fetus. Descriptive statistics, logistic regression analysis to determine the factors impacting maternal outcomes, and t-tests to evaluate differences in continuous variables were used in the statistical study. Statistical significance was defined as a p-value of less than 0.05. **Results**: The subjects' mean gestational age at the diagnosis of arrhythmia was 22.31 ± 6.84 weeks, and their mean age was 29.57 ± 5.2 years. The most prevalent arrhythmia was atrial fibrillation (34.15%), which was followed by ventricular tachycardia (15.45%) and atrial flutter (19.11%). The most frequent underlying cause was hypertensive disorders (25.20%). Beta-blockers (39.84%), electrical cardioversion (14.63%), and pacemaker implantation (8.94%) were all part of the treatment. According to a logistic regression study, maternal outcomes such as preterm delivery, intrauterine growth restriction, and miscarriage were substantially correlated with primiparity, hypertension, and beta-blocker usage (p < 0.05). **Conclusion**: Pregnancy-related arrhythmias are linked to serious problems for both the mother and the fetus, and better results depend on early detection and effective treatment.

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Introduction

One of the most common cardiac issues that arises during pregnancy is cardiac arrhythmias [1]. In people with congenital heart disease, aging mothers, or pre-existing cardiac disorders, these may appear for the first time or worsen [2]. Pregnancy-related arrhythmias are dangerous because they may have a negative impact on the health of the mother and the fetus [3]. Comprehensive clinical assessments and standardized diagnostic approaches, as highlighted in pediatric and hematological studies, are essential to identify underlying conditions that may predispose to arrhythmias [4-6]. These hazards might manifest as anything from minor symptoms like palpitations to serious consequences including intrauterine development restriction and heart arrest [7].

The development of arrhythmias is significantly influenced by the physiological adaptations of pregnancy, such as changes in hemodynamics and hormonal variations [8]. Along with an increased heart rate and changed autonomic tone, pregnancy is linked to a 20% to 45% increase in cardiac output and blood volume [9]. Myocardial stretch brought on by these alterations causes electrical instability and ionic channel activation, which may contribute to arrhythmias [10]. Experimental investigations on animal models have also revealed the role of hormones, including elevated estrogen levels, in arrhythmogenesis [11].

Pregnancy arrhythmias are especially linked to structural heart abnormalities, such as cardiomyopathies and valvular heart disorders [12]. This is supported by studies on congenital heart defects in pediatric populations [13]. Further predisposing women to arrhythmias include pregnancy-related problems such thyroid dysfunction and hypertensive disorders [14]. Certain arrhythmias, such tachyarrhythmias and total atrioventricular blocks, need prompt treatment to avoid potentially fatal consequences, whereas other arrhythmias are benign and self-limiting [15].

Given the possible hazards to the mother and fetus from diagnostic and treatment procedures, managing arrhythmias during pregnancy is very difficult [16]. Tailored pharmacological strategies that consider patient-specific genetic and environmental factors, as suggested in antiviral and chronic disease research, may improve maternal-fetal safety [17,18].

The status of the pregnant patient must be carefully considered while implementing modality such cardioversion, anti-arrhythmic drugs, and pacemaker placement [19]. To better management techniques and maternal-fetal outcomes, further research is necessary since there is a lack of data on the results of such treatments.

Objective

This study aims were to evaluate the types of arrhythmias in pregnancy, their underlying causes, management strategies, and clinical outcomes to provide insight into effective treatment approaches for this population.

Materials and Methods

Study Design

This was a prospective observational study conducted from January 2023 to December 2023 across two major healthcare institutions in Peshawar, Pakistan. The study was carried out at the Department of Cardiac Electrophysiology, Hayatabad Medical Complex, and the Department of Gynaecology, Lady Reading Hospital.

Inclusion and Exclusion Criteria

Pregnant women having an arrhythmia diagnosis met the study's inclusion requirements, regardless of whether the arrhythmia arose during pregnancy or the peripartum period or was pre-existing. We also included women who were diagnosed with a variety of arrhythmias based on clinical and ECG findings, such as atrial fibrillation, atrial flutter, ventricular arrhythmias, bradyarrhythmias, and atrioventricular blocks. Pregnant women with arrhythmias unrelated to the physiological changes of pregnancy or without a confirmed diagnosis of arrhythmia, women with known chronic cardiac diseases not related to pregnancy or arrhythmias, such as severe congenital heart defects or long-standing heart failure, and non-pregnant women or those without any cardiac complications during pregnancy were excluded.

Sample Size

The research comprised 246 pregnant women who

had been diagnosed with arrhythmias and related cardiac problems. Convenient sampling was used to choose participants, guaranteeing inclusion based on predetermined criteria and availability. Assuming a 20% predicted prevalence, statistical analysis was used to establish the sample size needed to attain a 95% confidence level and a 5% margin of error. The large sample size enables accurate outcome estimates and significant understanding of the treatment and consequences of pregnant arrhythmias.

Data Collection

Data, including demographics like age, parity, gestational age at arrhythmia diagnosis, and pre-existing illnesses like thyroid dysfunction or hypertension, were gathered from participant medical records, clinical assessments, and interviews. ECGs and Holter monitoring were used to identify the kinds of arrhythmias as needed, and clinical presentations included symptoms including palpitations, dizziness, syncope, and chest discomfort. The underlying reasons, such as hormonal impacts, hypertensive illnesses, and structural cardiac problems, were evaluated. The reported management options included pacemaker placement, electrical cardioversion, pharmaceutical therapies, and other operations. To assess difficulties throughout the postpartum phase, maternal and fetal outcomes, including preterm delivery, intrauterine growth restriction, miscarriage, and neonatal health, were also documented.

Statistical Analysis

SPSS (version 25) statistical software was used to examine the data. Baseline information, such as the prevalence of arrhythmia types, demographics, and pregnancy outcomes, were summarized using descriptive statistics. Categorical data were shown as percentages and frequencies, and continuous variables as means with standard deviations. To evaluate differences between the various kinds of arrhythmias in continuous variables like as age and gestational age, t-tests were used. In order to determine the parameters impacting maternal outcomes in pregnancy with arrhythmias, logistic regression analysis was also conducted. Statistical significance was defined as a p-value of less than 0.05.

Ethical Approval

The research received ethical clearance from Hayatabad Medical Complex institutional ethics committees. All participants received comprehensive information regarding the goals, methods, possible hazards, and advantages of the research prior to recruitment. All participants provided written informed permission, guaranteeing their voluntary involvement in the research.

Results

The research included 246 pregnant women with arrhythmias who ranged in age from 18 to 42 years old, with a mean age of 29.57 ± 5.2 years. Of the participants, 52.85% (130 women) were multipara and 47.15% (116 women) were primipara (table 1). At the diagnosis of arrhythmia, the average gestational age was 22.31 ± 6.84 weeks. Pre-existing conditions included diabetes mellitus in 7.71% (19 women), thyroid dysfunction in 13.82% (34 women), hypertension in 25.21% (62 women), and cardiomyopathies in 5.69% (14 women). Other pre-existing illnesses were present in 8.13% (20 women). Palpitations were the most frequent clinical manifestation (72.36%, 178 women), followed by dizziness (37.80%, 93 women), exhaustion (21.95%, 54 women), syncope (19.11%, 47 women), shortness of breath (15.45%, 38 women), nausea/vomiting (10.57%, 26 women), and chest discomfort (25.21%, 62 women).

Table 1: Demographic Information, Pre-Existing Medical Conditions, and Clinical Presentation of Arrhythmia Symptoms in Pregnant Women

Variable		Number of Patients (n;%)
Age	(Mean ± SD)	29.57 ± 5.2 years
Age Range	Years	18–42
Parity	Primipara	116 (47.15)
	Multipara	130 (52.85)
Gestational Age at	Weeks	22.31 ± 6.84

Diagnosis		
Pre-existing Conditions	Hypertension	62 (25.21)
	Thyroid Dysfunction	34 (13.82)
	Diabetes Mellitus	19 (7.71)
	Cardiomyopathies	14 (5.69)
	Other Pre-existing Conditions	20 (8.13)
Clinical Presentations	Palpitations	178 (72.36)
	Dizziness	93 (37.80)
	Syncope	47 (19.11)
	Chest Pain	62 (25.21)
	Fatigue	54 (21.95)
	Shortness of Breath	38 (15.45)
	Nausea/Vomiting	26 (10.57)

The distribution of arrhythmia types found in the research of 246 pregnant women using Holter monitoring and ECG is shown in Figure 1. Atrial fibrillation was the most prevalent arrhythmia, occurring in 34.15% of the participants (84 women). The second most common condition was atrial flutter, which affected 19.11% of the women (47), and ventricular tachycardia, which affected 15.45% of the women (38). Atrioventricular block was found in 12.20% (30 women) and bradyarrhythmias in 13.01% (32 women). Ventricular fibrillation was seen in 2.85% (7 women) and supraventricular tachycardia in 6.10% (15 women). Other forms of arrhythmias were present in 23 women, or 9.35% of the total.
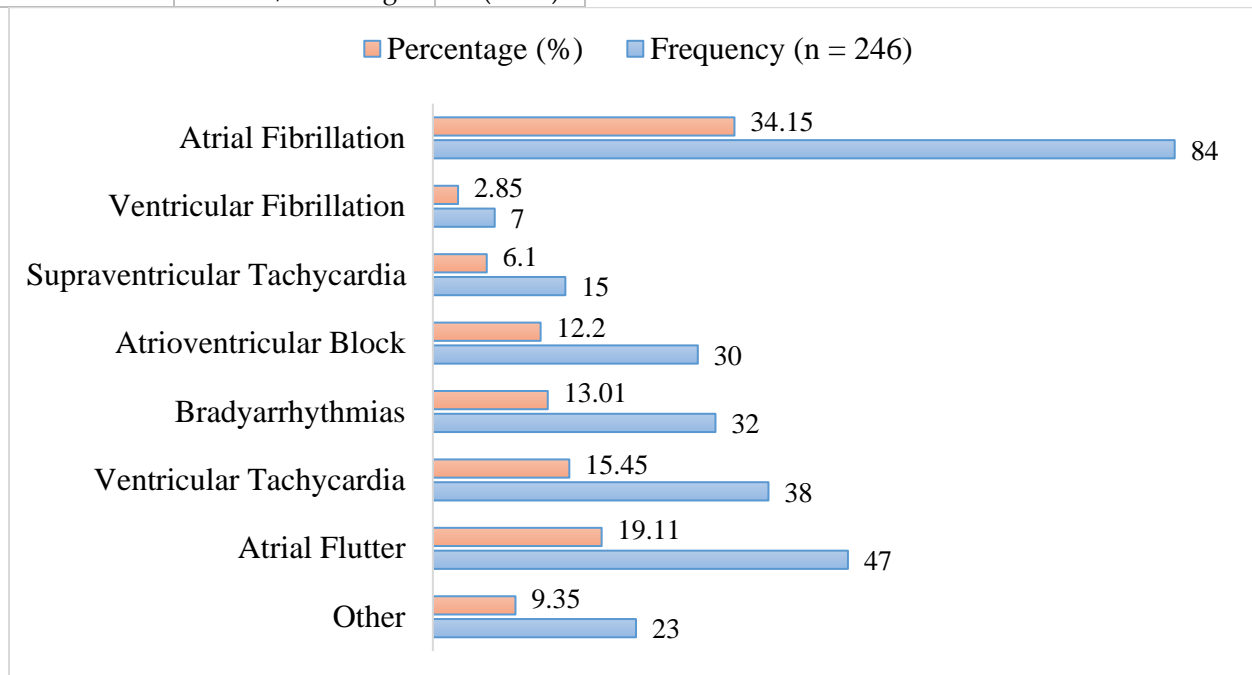

Figure 1: Types of Arrhythmia Identified Through ECG and Holter Monitoring

The fundamental causes and therapy approaches for pregnant women's arrhythmias are highlighted in Table 2. Of the participants, the most prevalent cause was hypertensive disorders, which affected 25.20% (62 women). Structural heart illnesses, including valvular heart disease in 12.60% (31 women) and cardiomyopathies in 9.35% (23 women), came next. Thyroid dysfunction and other hormonal impacts were seen in 19.92% (49 women) and 13.82% (34 women), respectively. 10.98% of the women (27 women) had electrolyte abnormalities, 7.32% had pregnancy-related anemia (18 women), and 6.10% had other reasons (15 women). With beta-blockers provided to 39.84% (98 women), calcium channel blockers to 21.95% (54 women), and anti-arrhythmic medications to 19.51% (48 women), pharmacological therapy was the most popular method of care. Pacemaker implantation occurred in 8.94% (22 women) and electrical cardioversion in 14.63% (36 women). While lifestyle changes were advised for 27.64% (68 women), catheter ablation was used for 4.88% (12 women). For 17.89% (44 women), observation was considered adequate on its own.

Table 2: Underlying Causes and Management Strategies for Arrhythmias in Pregnancy

Category	Subcategory/Detail		Frequency (n; %)
Underlying Causes	Hypertensive Disorders		62 (25.20%)
	Structural Heart Diseases	Valvular Heart Disease	31 (12.60%)
		Cardiomyopathies	23 (9.35%)
	Hormonal Influences		49 (19.92%)
	Thyroid Dysfunction		34 (13.82%)
	Electrolyte Imbalances		27 (10.98%)
	Pregnancy-Related Anemia		18 (7.32%)
	Other Causes		15 (6.10%)
Management Strategies	Pharmacological Treatment	Beta-Blockers	98 (39.84%)
		Calcium Channel Blockers	54 (21.95%)
		Anti-arrhythmic Drugs	48 (19.51%)
	Electrical Cardioversion		36 (14.63%)
	Pacemaker Insertion		22 (8.94%)
	Catheter Ablation		12 (4.88%)
	Lifestyle Modifications		68 (27.64%)
	Observation Only		44 (17.89%)

The results for both the mother and the fetus in pregnant women with arrhythmias are shown in Table 3. Of them, 26.02% (64 women) had preterm delivery, 19.51% (48 women) had intrauterine growth restriction (IUGR), and 8.94% (22 women) miscarried. Neonatal problems included low birth weight in 12.20% (30 newborns) and neonatal difficulties after giving birth.

intensive care unit hospitalization in 18.29% (45 infants). Of the difficulties that mothers faced after giving birth, 10.57% (26 women) had persistent arrhythmias and 13.41% (33 women) had heart failure. Nonetheless, a noteworthy percentage of women healed without serious problems, as seen by the 45.53% (112 women) who had no substantial

Table 3: Maternal and Fetal Outcomes for Arrhythmias in Pregnancy

Outcome	Frequency (n; %)
Preterm Birth (<37 weeks)	64 (26.02)
Intrauterine Growth Restriction (IUGR)	48 (19.51)
Miscarriage	22 (8.94)
Neonatal Complications	
Neonatal ICU Admission	45 (18.29)
Low Birth Weight (<2.5 kg)	30 (12.20)
Maternal Postpartum Complications	
Heart Failure	33 (13.41)
Persistent Arrhythmias	26 (10.57)
No Significant Complications	112 (45.53)

The findings of t-tests comparing age and gestational age at diagnosis for various arrhythmia types are shown in Table 4. There are no discernible age differences between women with various arrhythmia types, according to the p-values for age,

which range from 0.269 to 0.702. Likewise, there are no appreciable variations in the time of diagnosis across the various kinds of arrhythmias, as shown by the p-values for gestational age at diagnosis, which range from 0.324 to 0.672. These findings suggest that

the kind of pregnant arrhythmia in this research group is not substantially influenced by either age or gestational age.

Table 4: T-tests for Differences in Continuous Variables (Age and Gestational Age) Across Different Arrhythmia Types

Arrhythmia Type	Age (Mean ± SD)	Gestational Age at Diagnosis (Mean ± SD)	T-test p-value for Age	T-test p-value for Gestational Age
Atrial Fibrillation	29.45 ± 5.63	23.14 ± 7.22	0.381	0.510
Atrial Flutter	28.91 ± 4.92	21.43 ± 6.54	0.287	0.324
Ventricular Tachycardia	30.08 ± 6.17	24.06 ± 8.19	0.415	0.488
Bradyarrhythmias	29.35 ± 5.25	21.89 ± 6.98	0.522	0.402
Atrioventricular Block	30.40 ± 5.86	22.23 ± 7.51	0.269	0.413
Supraventricular Tachycardia	29.70 ± 4.32	22.52 ± 6.43	0.702	0.329
Ventricular Fibrillation	28.21 ± 5.31	19.91 ± 5.04	0.694	0.672
Other	29.12 ± 5.08	22.76 ± 7.08	0.460	0.554

The findings of a logistic regression study looking at variables affecting maternal outcomes in pregnancy with arrhythmias are shown in Table 5. Different results were substantially correlated with a number of parameters. Higher chances of miscarriage (OR 2.04, p = 0.021), intrauterine growth restriction (IUGR) (OR 2.15, p = 0.012), and preterm delivery (OR 2.56, p = 0.002) were associated with primiparity (first-time pregnancy). Increased chances of miscarriage (OR 3.15, p = 0.003), heart failure (OR 2.78, p = 0.002), persistent arrhythmias (OR 2.22, p = 0.004), IUGR (OR 2.56, p = 0.004), and preterm delivery (OR 2.98, p = 0.001) were linked to hypertension. Preterm birth was significantly predicted by gestational age upon diagnosis (OR 1.07, p = 0.048), but not for other outcomes. A higher risk of preterm delivery (OR 2.15, p = 0.019), IUGR (OR 2.22, p = 0.029), miscarriage (OR 2.11, p = 0.035), heart failure (OR 2.48, p = 0.022), and persistent arrhythmias (OR 2.74, p = 0.016) was also substantially linked to beta-blocker usage. While age had a little correlation with IUGR (OR 1.03, p = 0.088), it had no discernible effect on the majority of outcomes. These data imply that primiparity, hypertension, and beta-blocker usage are major variables leading to unfavorable maternal outcomes in this group.

Table 5: Logistic Regression Analysis for Factors Influencing Maternal Outcomes in Pregnancy with Arrhythmias

Factor	Outcome	Odds Ratio (OR)	95% CI	p-value
Parity (Primipara vs Multipara)	Preterm Birth	2.56	1.38 - 4.75	0.002
	Intrauterine Growth Restriction (IUGR)	2.15	1.17 - 3.98	0.012
	Miscarriage	2.04	1.08 - 3.85	0.021
	Heart Failure	1.78	0.95 - 3.33	0.076
	Persistent Arrhythmias	1.34	0.75 - 2.39	0.214
	No Significant Complications	0.76	0.47 - 1.22	0.335
Hypertension (Yes vs No)	Preterm Birth	2.98	1.62 - 5.48	0.001
	Intrauterine Growth Restriction (IUGR)	2.56	1.39 - 4.73	0.004
	Miscarriage	3.15	1.58 - 6.27	0.003
	Heart Failure	2.78	1.44 - 5.37	0.002
	Persistent	2.22	1.29 - 3.82	0.004

	Arrhythmias			
	No Significant Complications	0.73	0.51 - 1.05	0.082
Gestational Age at Diagnosis	Preterm Birth	1.07	1.00 - 1.14	0.048
	Intrauterine Growth Restriction (IUGR)	1.04	0.97 - 1.12	0.322
	Miscarriage	1.06	0.97 - 1.16	0.077
	Heart Failure	1.03	0.97 - 1.11	0.215
	Persistent Arrhythmias	1.02	0.96 - 1.09	0.443
	No Significant Complications	0.99	0.95 - 1.04	0.344
Beta-Blockers (Yes vs No)	Preterm Birth	2.15	1.14 - 4.08	0.019
	Intrauterine Growth Restriction (IUGR)	2.22	1.13 - 4.39	0.029
	Miscarriage	2.11	1.08 - 4.13	0.035
	Heart Failure	2.48	1.15 - 5.29	0.022
	Persistent Arrhythmias	2.74	1.19 - 6.31	0.016
	No Significant Complications	0.84	0.54 - 1.31	0.125
Age (Years)	Preterm Birth	1.02	0.99 - 1.05	0.246
	Intrauterine Growth Restriction (IUGR)	1.03	1.00 - 1.07	0.088
	Miscarriage	1.01	0.98 - 1.04	0.389
	Heart Failure	1.01	0.99 - 1.04	0.422
	Persistent Arrhythmias	1.00	0.98 - 1.02	0.784
	No Significant Complications	1.00	0.98 - 1.02	0.822

Discussion

Pregnancy arrhythmias are a serious issue since they may have a negative impact on the health of the mother and the fetus. Atrial fibrillation was the most prevalent kind of arrhythmia in pregnant women, affecting 34.15% (84 women) of the participants in our research. This is in line with other studies that found atrial fibrillation to be the most common arrhythmia during pregnancy, albeit estimates vary greatly, ranging from 15% to 40% in different studies [20]. Our results underscore the increasing awareness of the prevalence of cardiac arrhythmia during pregnancy, especially in women with advanced maternal age or structural heart disease.

The next most prevalent arrhythmias in our cohort, on the other hand, were ventricular tachycardia (15.45%) and atrial flutter (19.11%), which is consistent with findings in related studies that show tachyarrhythmias, both supraventricular and ventricular, to be important contributors to arrhythmogenic events during pregnancy [1]. Intriguingly, bradyarrhythmias (13.01%) and atrioventricular blocks (12.20%) were discovered to occur frequently in our group, which is consistent with findings from earlier research that revealed that the incidence of bradycardic arrhythmias during pregnancy was between 10% and 15% [16]. These arrhythmias are often associated with autonomic nervous system oscillations and hemodynamic alterations brought on by pregnancy.

With respect to the underlying causes of arrhythmias, our study revealed that hypertensive

disorders were the most prevalent underlying disease, involving 25.20% (62 women) of participants. This finding is in line with previous research that demonstrated hypertension to be a significant risk factor for pregnancy-related arrhythmias [21]. Comorbid conditions, including anemia, thyroid dysfunction, and other metabolic or hematological abnormalities, have been shown in other clinical studies to influence cardiac outcomes [22-25].

In line with other studies that found a higher frequency of arrhythmias in pregnant women with pre-existing cardiac disorders, structural heart disease, such as valvular heart disease (12.60%) and cardiomyopathies (9.35%), was also prevalent [26]. Furthermore, 13.82% (34 women) of patients had thyroid dysfunction, which is consistent with data from a previous research that revealed a link between thyroid abnormalities and pregnancy arrhythmogenesis [27].

The most common management strategy in our group was pharmaceutical therapy, with 39.84% (98 women) of patients using beta-blockers. Given their safety profile, beta-blockers are recommended as the first-line therapy for pregnancy-related arrhythmias, which is in accordance with current recommendations [28]. Nonetheless, a significant percentage of cases needed pacemaker placement (8.94%) and electrical cardioversion (14.63%), indicating the severity of arrhythmias in this group. Electrical cardioversion has been used in 10–20% of instances, particularly in persistent supraventricular arrhythmias, according to a previous research by Ramlakhan et al. [29].

Our study's maternal results were alarming; the most frequent problems were intrauterine growth restriction (IUGR) (19.51%) and preterm delivery (26.02%). These results are in line with earlier research that showed pregnant women with arrhythmias had a greater risk of preterm delivery and IUGR [30]. Additionally, this research found a strong correlation between hypertension and unfavorable maternal outcomes, such as miscarriage (OR 3.15, p = 0.003), IUGR (OR 2.56, p = 0.004), and preterm delivery (OR 2.98, p = 0.001). These results are in line with a prior research that found that high

blood pressure during pregnancy is a major risk factor for adverse outcomes for both the mother and the fetus [31].

Study Strengths and Limitations

Our study's strength is its large sample size, prospective design, and thorough evaluation of the various arrhythmia types and the related consequences for both the mother and the fetus. The results' generalizability is improved by the multi-center strategy, which involves two significant healthcare facilities. The research also sheds important light on how underlying illnesses including thyroid issues, hypertension, and structural heart disorders affect the incidence and treatment of arrhythmias during pregnancy. There are some significant restrictions, however. The research was carried out in a particular region, which may restrict its relevance to people with varying socioeconomic or healthcare access situations, and the use of easy sampling may introduce selection bias. Finally, since the research was observational in nature, causation cannot be shown with certainty. To validate our results and investigate possible treatment approaches further, additional controlled studies would be required.

Conclusion

This research concludes by highlighting the substantial negative effects of pregnancy arrhythmias on the health of both the mother and the fetus, especially in women who already have underlying medical disorders including thyroid dysfunction and hypertension. Our results imply that lowering the likelihood of unfavorable outcomes, such as preterm delivery and intrauterine growth restriction, requires prompt diagnosis and effective treatment techniques. In order to improve treatment protocols and maximize outcomes for pregnant women with arrhythmias, further research with bigger sample sizes and multicenter data is required, even if pharmaceutical medications and interventions such electrical cardioversion and

Conflict of interest

The authors declared no conflict of interest.

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