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Original Article

Prevalence, Risk Factors, and Maternal Outcomes of Atrial Fibrillation during Pregnancy

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Abstract

Objectives: This study aims to assess the prevalence, identify contributing risk factors, and evaluate the maternal outcomes associated with atrial fibrillation (AF) during pregnancy.

Methodology: A prospective cohort study was conducted between July 2022 and June 2024, involving 150 pregnant women diagnosed with AF. Data on demographics, medical history, and clinical outcomes were collected through structured patient interviews, clinical examinations, and standardized diagnostic tools, including electrocardiograms (ECG) and echocardiography.

Results: The mean age of participants was 29.4 years, with an average body mass index (BMI) of 25.1 kg/m². Hypertension (45%) and diabetes (18%) were the most prevalent comorbidities. More than half of the participants were aged 35 years or older. Atrial fibrillation was diagnosed at an average gestational age of 24.5 weeks. Maternal outcomes included heart failure in 9.3% of cases, thromboembolic events in 5.7%, and 42% of pregnancies requiring cesarean section. Vaginal delivery was achieved in 58% of cases. Preterm labor occurred in 16% of pregnancies. Neonatal outcomes included a 12% NICU admission rate and a neonatal mortality rate of 1.5%. The average birth weight was 2,800 grams, with Apgar scores of 7.2 at one minute and 8.5 at five minutes.

Conclusion: Atrial fibrillation during pregnancy is associated with significant maternal and neonatal complications, including heart failure, thromboembolic events, and preterm birth. These findings underscore the importance of close monitoring and individualized care for pregnant women with AF. Further research is necessary to develop targeted intervention strategies to improve maternal and neonatal outcomes for this high-risk group.

Keywords: Atrial fibrillation, pregnancy, maternal outcomes, neonatal outcomes, risk factors, arrhythmia in pregnancy, maternal health

INTRODUCTION

Atrial fibrillation (AF) during pregnancy presents unique challenges and significantly increases the risk of maternal complications, such as heart failure, thromboembolic events, and preterm birth. With the increasing trend of advanced maternal age and the higher prevalence of comorbidities like hypertension and diabetes, AF in pregnancy has emerged as a critical concern in maternal health [1]. Chronic AF during pregnancy further complicates these risks, and a comprehensive understanding of its incidence, risk factors, and consequences is essential for improving clinical management strategies for these women [2].

AF during pregnancy is often associated with adverse outcomes, both for the mother and the fetus. A meta-analysis on AF in pregnancy indicated that the condition affects up to 2.2% of pregnancies under intensive surveillance, with a recurrence rate of up to 39% in women with a history of AF prior to pregnancy [3]. This increasing prevalence is largely attributed to rising maternal age and a growing incidence of structural heart disease. As such, AF during pregnancy poses a significant burden on maternal health and requires heightened clinical attention [4].

Several risk factors for AF during pregnancy have been identified, including pre-existing heart conditions, hypertension, and obesity. Pregnancy-specific conditions, such as pre-eclampsia and gestational diabetes, further increase the risk of developing AF. Studies conducted in the US have found a strong association between AF in pregnancy and prolonged hospital stays, higher rates of maternal mortality, and increased healthcare costs, further emphasizing the importance of early detection and management [5].

The maternal consequences of AF during pregnancy are severe. Women with AF are at an increased risk of developing heart failure, thromboembolic events, and, in some cases, higher rates of maternal mortality compared to other pregnant women. Additionally, fetal outcomes are negatively impacted, with an increased likelihood of preterm birth, low birth weight, and the need for neonatal intensive care unit (NICU) admissions [6]. These concerns highlight the need for vigilant monitoring and tailored

management strategies to ensure the health of both the mother and the fetus.

In managing AF in pregnancy, a careful balance must be maintained between effective pharmacological treatment and minimizing harm. Direct current cardioversion has demonstrated high success rates and relative safety in pregnancy, making it a valuable option for managing AF in this population [7]. Beta-blockers and digoxin are commonly used to control heart rate, while antithrombotic therapy must be carefully considered, weighing the risks of thromboembolic events against potential bleeding complications.

Although AF in pregnant women is associated with serious maternal and neonatal complications, including heart failure, thromboembolic events, and preterm birth, the global prevalence of AF is relatively low, affecting 1-2% of the general population, with up to 2.2% of high-risk pregnancies being affected [8]. However, research on AF in pregnancy, particularly in resource-limited settings like Pakistan, remains sparse. The lack of regional data on AF prevalence, treatment outcomes, and associated risk factors hinders efforts to improve clinical management in these settings. Pregnant women with pre-existing hypertension, diabetes, or structural heart disease are disproportionately affected, yet their outcomes in low-resource environments remain underreported [9].

This study seeks to fill these critical gaps by examining the prevalence, risk factors, and maternal and neonatal outcomes of AF in a South Asian population. The findings will inform the development of region-specific management strategies and enhance the care of this high-risk group. As AF is highly prevalent among pregnant women and associated with severe maternal and neonatal outcomes, it is essential to develop innovative diagnostic, preventive, and management approaches. Identifying risk factors for AF in pregnancy and providing timely interventions can significantly improve outcomes for both mother and child. Further investigation into AF in different regions of the world will help us to better understand this complex condition and develop tailored care strategies for expectant mothers.

METHODOLOGY

Study Design: This prospective cohort study was conducted to assess the maternal and neonatal outcomes of pregnant women diagnosed with atrial fibrillation (AF). The study followed a longitudinal design to collect real-time data from July 2022 to June 2024 at the Department of Cardiology, Hayatabad Medical Complex (HMC), Peshawar. A prospective design was chosen to ensure continuous and precise data collection, allowing for close tracking of outcomes over the course of pregnancy. This design minimizes recall bias commonly associated with retrospective studies and ensures timely intervention for participants in case of complications.

Ethics: The study adhered to ethical guidelines and was approved by the Institutional Review Board (IRB) of Hayatabad Medical Complex, Peshawar. Written informed consent was obtained from all participants after they were provided with clear explanations regarding the study's purpose, methods, potential risks, and benefits. Participation was voluntary, and participants were informed of their right to withdraw at any stage without penalty. Confidentiality was strictly maintained, and all participant data were anonymized prior to analysis. The study followed the ethical principles outlined in the Declaration of Helsinki, ensuring patient safety, privacy, and well-being.

Setting: This study was conducted in the Department of Cardiology at Hayatabad Medical Complex, a tertiary healthcare facility located in Peshawar, Pakistan. The hospital serves a large and diverse population, providing comprehensive care for pregnant women, including those diagnosed with AF. The setting allows for the collection of clinical data from a broad range of patients, ensuring a robust sample for analysis.

Participants: The study sample consisted of 150 pregnant women diagnosed with atrial fibrillation (AF). Inclusion criteria required women to be diagnosed with AF based on standard ECG criteria (absence of P waves, irregularly irregular R-R intervals, and fibrillatory waves) and to provide informed consent. Participants with other significant arrhythmias (e.g., ventricular arrhythmias), severe systemic illnesses (e.g., organ failure), or those who

declined participation were excluded. Additionally, pregnant women diagnosed with gestational diabetes or other pregnancy-specific conditions were excluded to avoid confounding effects that might independently influence maternal and neonatal outcomes.

Variables: The primary outcome variables included maternal complications (e.g., heart failure, thromboembolic events, need for cardioversion, hospitalization duration, and maternal mortality), obstetric outcomes (e.g., mode of delivery, gestational age at delivery, preterm birth, and postpartum hemorrhage), and neonatal outcomes (e.g., birth weight, Apgar scores, neonatal intensive care unit [NICU] admission, and neonatal mortality). Independent variables included demographic characteristics (e.g., age, BMI, medical history), obstetric history (e.g., gravidity, parity, previous complications), and clinical measures (e.g., ECG, echocardiography findings).

Data Sources/Measurement: Data were collected through a combination of structured interviews, clinical examinations, and the review of medical records. Patient interviews and medical records were utilized to gather demographic and obstetric history, including details such as age, weight, height, BMI, parity, gravidity, previous pregnancies, and any related complications. Information on comorbid conditions, such as hypertension, diabetes, and pre-existing heart disease, was extracted from patient records and interviews. A standard 12-lead electrocardiogram (ECG) was used to diagnose atrial fibrillation (AF), while echocardiography was performed to assess cardiac function and identify any structural abnormalities. Maternal and neonatal outcomes were measured through clinical examinations, structured interviews, and medical record reviews, with a focus on maternal complications like heart failure and thromboembolic events, as well as neonatal outcomes such as birth weight and Apgar scores.

Bias: To minimize selection and measurement biases, strict inclusion and exclusion criteria were applied. Participants with conditions that could confound the results, such as gestational diabetes or other pregnancy-specific illnesses, were excluded. Furthermore, the diagnosis of AF was confirmed by a

cardiologist using standardized ECG criteria, and echocardiography was used to assess cardiac function and identify structural abnormalities. To ensure consistency in outcome measurement, structured interviews and clinical examinations were performed by trained healthcare professionals.

Study Size: The study included 150 pregnant women diagnosed with AF. The sample size was determined based on an expected AF prevalence of approximately 2% in pregnant women, with an anticipated effect size of 10% for maternal complications. This calculation ensured the study had adequate power (80%) and a 95% confidence level to detect statistically significant differences in primary outcomes such as heart failure and thromboembolic events. The sample size was sufficient to draw reliable conclusions about the impact of AF on maternal and neonatal outcomes in this population.

Quantitative Variables: Continuous variables were measured and analyzed, including maternal weight, height, BMI, age, and gestational age at the diagnosis of AF. Neonatal outcomes such as birth weight and Apgar scores were also recorded as continuous variables. These quantitative variables were analyzed to identify any significant relationships between AF and the outcomes of interest.

Statistical Methods: Data were analyzed using SPSS version 25.0. Continuous variables were presented as means \pm standard deviations, and categorical variables were reported as frequencies and percentages. The Chi-square test was used to analyze group differences for categorical variables, while t-tests were employed for continuous variables. Multivariate logistic regression analysis was performed to identify independent predictors of maternal and neonatal complications. This approach allowed for the adjustment of confounding factors and provided more accurate estimates of the associations between AF and pregnancy outcomes. A significance level of $p < 0.05$ was set to determine statistical significance.

RESULTS

Participants: A total of 150 pregnant women diagnosed with atrial fibrillation (AF) were included in this study. The average age of participants was 29.4

years, with over half of the participants aged 35 years or older. The mean body mass index (BMI) of the participants was 25.1 kg/m², indicating a moderately overweight population. Participants had an average parity of 2.3 children, with a mean gravidity of 3.1. Comorbidities were prevalent, with hypertension being the most common (45%), followed by diabetes (18%) and pre-existing structural heart disease (22%). The mean gestational age at the diagnosis of AF was 24.5 weeks, indicating that AF was diagnosed in the second trimester for most participants. A summary of the demographic characteristics of the study population is provided in Table 1.

Table 1: Demographic Characteristics of Study Population

Parameter	Summary
Mean Age (years)	29.4
Mean BMI (kg/m ²)	25.1
Parity (mean)	2.3
Gravidity (mean)	3.1
Comorbid Conditions	
Hypertension (%)	45
Diabetes (%)	18
Pre-existing Heart Disease (%)	22

Outcome Data: Maternal complications associated with AF in pregnancy were notable. Heart failure was observed in 9.3% of participants, while thromboembolic events occurred in 5.7%. A small proportion (3.4%) of women required cardioversion. The average duration of hospitalization for these patients was 7.8 days, and the maternal mortality rate was 2%. Significant associations were found between maternal comorbidities, such as hypertension ($p=0.02$) and pre-existing heart disease ($p=0.01$), and adverse maternal outcomes. A more detailed breakdown of maternal outcomes is presented in Table 2.

Table 2: Maternal Outcomes

Outcome	Summary
Heart Failure	9.3%
Thromboembolic Events	5.7%
Need for Cardioversion	3.4%
Hospitalization Duration (days)	7.8
Maternal Mortality	2%

Obstetric Outcomes: Obstetric outcomes were also assessed, with 58% of the participants delivering vaginally and 42% undergoing cesarean section. Preterm birth occurred in 16% of pregnancies, and postpartum hemorrhage was observed in 5%. These

findings suggest a relatively high incidence of preterm delivery and complications during childbirth in women with AF. Detailed obstetric outcomes are shown in Table 3.

Table 3: Obstetric Outcomes

Outcome	Summary
Vaginal Delivery	58%
Cesarean Section	42%
Preterm Birth	16%
Postpartum Hemorrhage	5%

Neonatal Outcomes: Neonatal outcomes were also evaluated, with the mean birth weight of neonates being 2.8 kg. Preterm births contributed to 16% of the total neonatal cases, highlighting a significant concern for premature delivery in this cohort. The Apgar scores averaged 7.2 at one minute and 8.5 at five minutes, reflecting generally good neonatal outcomes. However, 12% of neonates required admission to the neonatal intensive care unit (NICU), and neonatal mortality was recorded at 1.5%. These results are summarized in Table 4.

Table 4: Neonatal Outcomes

Outcome	Summary
Birth Weight (kg) (mean)	2.8
Apgar Score at 1 min (mean)	7.2
Apgar Score at 5 min (mean)	8.5
NICU Admission	12%
Neonatal Mortality	1.5%

Main Results: Risk factor analysis revealed several key associations. Hypertension, advanced maternal age (≥ 35 years), and pre-existing structural heart disease were significantly linked to adverse maternal outcomes, including heart failure and thromboembolic events. A third-trimester diagnosis of AF was particularly associated with an increased risk of thromboembolic events ($p < 0.01$). These findings underscore the need for targeted monitoring and management of pregnant women with AF, especially those with underlying comorbidities. The detailed statistical analysis of risk factors and their associated outcomes is presented in Table 5.

DISCUSSION

This study aimed to assess the prevalence, risk factors, and maternal and neonatal outcomes associated with atrial fibrillation (AF) in pregnant women at Hayatabad Medical Complex, Peshawar.

The findings underscore the substantial maternal and neonatal complications related to AF, including heart failure, thromboembolic events, preterm births, and neonatal intensive care unit (NICU) admissions. Hypertension, advanced maternal age, and pre-existing structural heart disease were identified as the most significant risk factors, highlighting the urgent need for early identification and tailored management strategies in high-risk pregnancies [10].

Table 5: Risk Factor Analysis

Risk Factor	Associated Outcome	P-value
Hypertension	Heart Failure	0.02
Pre-existing Heart Disease	Thromboembolic Events	0.01
Advanced Maternal Age (≥ 35 years)	Heart Failure	0.03
Third-Trimester Diagnosis	Thromboembolic Events	< 0.01

The results are consistent with global trends regarding AF prevalence and outcomes in pregnancy. The mean age of participants was 29.4 years, which is younger compared to cohorts in higher-income countries, where advanced maternal age is more commonly observed. This may reflect regional differences in demographics and reproductive behaviors, with women in lower-income settings often having children at younger ages [11]. Hypertension (45%) and diabetes (18%) were prevalent comorbidities, aligning with established risk factors for AF, as reported in previous studies. Similar research from low- and middle-income countries (LMICs) has documented high rates of maternal complications, including heart failure and thromboembolic events, further emphasizing the risks associated with AF in pregnancy. Notably, the cesarean section rate (42%) and preterm birth rate (16%) in this cohort are considerably high, necessitating a cautious obstetric approach to manage these high-risk pregnancies.

The study findings highlight the critical need for close monitoring and multidisciplinary care for pregnant women diagnosed with AF. Collaboration between cardiologists, obstetricians, and neonatologists is essential in developing individualized management plans to mitigate the risks posed by AF [6]. Given the significant impact of maternal AF on neonatal health, the high NICU admission rate (12%) and neonatal mortality rate (1.5%) underscore the importance of

enhanced neonatal monitoring and care strategies. The association between advanced maternal age and increased risk of thromboembolic events also suggests that targeted interventions based on age-related risks could lead to improved maternal and neonatal outcomes.

Study Limitations: This study was conducted at a single center, which limits the generalizability of the findings to broader populations or different healthcare settings. The relatively small sample size may also restrict the ability to detect rarer complications. Additionally, the absence of a control group and inconsistent data on baseline medication use may have influenced the interpretation of the results. These limitations point to the need for multicenter studies with larger, more diverse populations to validate these findings and enhance their applicability across different settings.

Future Directions: Future research should prioritize multicenter studies that include a broader regional and demographic range to capture the full spectrum of AF-related pregnancy outcomes. Investigating the long-term cardiovascular implications of AF in women after pregnancy would provide valuable insights into the management of this condition in the postpartum period. Furthermore, the development of predictive models to identify women at high risk for adverse maternal and neonatal outcomes could lead to earlier interventions and improved care. Exploring the genetic and environmental factors contributing to AF in LMICs could also provide deeper insights into the pathophysiology of AF during pregnancy and inform targeted prevention and management strategies.

CONCLUSION

Atrial fibrillation during pregnancy presents significant risks to both maternal and neonatal health, exacerbating complications such as heart failure, thromboembolic events, preterm births, and NICU admissions. The findings from this study emphasize the urgent need for early identification and targeted management of AF in high-risk pregnancies to reduce adverse outcomes. This research contributes valuable evidence to the growing body of literature on AF in pregnancy, particularly in resource-limited settings, where the burden of AF-related complications may be

even more pronounced. It highlights the critical role of multidisciplinary care, involving cardiologists, obstetricians, and neonatologists, in optimizing outcomes for both mother and child. Integrating AF screening into routine prenatal care and developing personalized management strategies based on maternal risk factors can significantly improve maternal and neonatal health outcomes. By focusing on region-specific data, this study underscores the need for tailored interventions and policy development to address the growing burden of AF in pregnancy, ultimately paving the way for improved clinical practices and future research in this area.

AUTHORS' CONTRIBUTION

FA and ZAK: Concept and design, data acquisition, interpretation, drafting, final approval, and agree to be accountable for all aspects of the work.

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