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*EP & Arrhythmia*

# Incidence and Time Course of Symptomatic Paroxysmal Supraventricular Tachycardia During Pregnancy: A Nation-Wide Database Study

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***Background:*** Paroxysmal supraventricular tachycardia (PSVT) is a common arrhythmia. However, its incidence and time course in pregnant women are unclear. This study was conducted to determine the incidence of PSVT in pregnant women by trimester.

***Methods:*** From 2001 to 2012, all pregnant women in Taiwan were monitored for PSVT events. Women who visited the emergency department or were admitted for symptomatic PSVT were enrolled in this study, and those with congenital heart diseases were excluded.

***Results:*** A total of 2,387,588 pregnancies (1,623,596 mothers) were analyzed. For the women with no previous history of a PSVT event, the incidence rates of symptomatic PSVT were 15, 33, and 60 per 100,000 pregnancies during the first, second, and third trimester, respectively. For the women with a previous history of PSVT, the incidence rates were 5625, 9525, and 11526 per 100,000 pregnancies, respectively. Most PSVT events occurred during the third trimester.

***Conclusions:*** In this Taiwanese cohort of pregnant women there was a stepwise increase in the incidence of symptomatic PSVT, which peaked during the third trimester. A past history of PSVT was associated with a higher risk of recurrence during pregnancy. We suggest that clinicians should be aware of this trend. Prompt management of PSVT events may prevent maternal and fetal complications.

**Key Words:** Arrhythmia • Paroxysmal supraventricular tachycardia • Pregnancy

## INTRODUCTION

Arrhythmia or palpitations during pregnancy are common and sometimes problematic.[1] Although most such arrhythmias are premature atrial or ventricular beats, paroxysmal supraventricular tachycardia (PSVT) is the most common type of arrhythmia, and it can cause severe symptoms.[2,3] A few studies have reported an increased incidence of PSVT during pregnancy,[4,5] however another case series reported that a first onset of PSVT was relatively rare during pregnancy.[6] The exact incidence of PSVT during pregnancy is unknown, and information about the distribution of PSVT and its variations by trimester is limited.

Banhidy et al. reported that PSVT in pregnant women was associated with a higher risk of fetal cardiac congenital abnormalities;[7] however, the design and small size of this single-center study limited the generalizability of its conclusions. Although PSVT has been con-

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sidered to be harmless in pregnant women, we previously reported that PSVT during pregnancy can cause adverse effects on maternal and fetal outcomes.[8] Therefore, understanding the incidence during pregnancy may increase awareness and prevent complications. In addition, we hypothesized that the incidence of PSVT may vary according to the stage of pregnancy. Therefore, we conducted this nationwide, population-based cohort study to compare the incidence of PSVT in pregnant women by trimester.

## METHODS

### Study site

This study was approved by the Institutional Review Board of Chang Gung Memorial Hospital and the Ministry of Health and Welfare, Taiwan. The need for informed consent was waived because the data were anonymized.

### Study cohort

We used the National Health Insurance Research Database (NHIRD) to identify all pregnancies in Taiwan between January 1, 2001, and December 31, 2012.[9] A total of 2,387,588 pregnancies were identified. Mothers with congenital heart diseases, those younger than 15 years or older than 44 years, those with a gap of less than 6 months or longer than 20 years between pregnancies, and with multiparity were excluded (Figure 1). All clinical information regarding the women was based on obstetricians' records. Gestational age was obtained primarily from birth registry records. Pregnancy onset, defined as the first day of the last menstrual period, was estimated by subtracting the gestational age from the delivery date. We defined the gestational age of the first 12 weeks, 13 to 24 weeks, and 25 weeks and later as the first, second, and third trimesters, respectively.

### Determination of PSVT

Women who were admitted to hospitals or visited an emergency department with an International Classification of Diseases, Ninth Revision Clinical Modification code of 427.0 as the primary diagnosis were defined as having symptomatic PSVT.

### Statistical analysis

The incidence rates of PSVT during the entire gestational period, in each trimester, and 1 year postpartum were estimated. The primary analysis included women with or without a history of PSVT before the current pregnancy. We also used adenosine prescriptions as a priori sensitivity analysis as an alternative case definition for PSVT.

## RESULTS

We examined the records of 1,623,596 mothers and 2,347,898 pregnancies. Of these pregnancies, 3,015 of the mothers had a previous history of symptomatic PSVT (PSVT group) and 2,344,883 did not (non-PSVT group). Their baseline characteristics are listed in Table 1. The PSVT group was relatively older and more likely to have chronic systemic diseases than the non-PSVT group, despite the small absolute difference.

In the non-PSVT group, the incidence rates of symptomatic PSVT were 15, 33, and 60 per 100,000 pregnancies during the first, second, and third trimester,

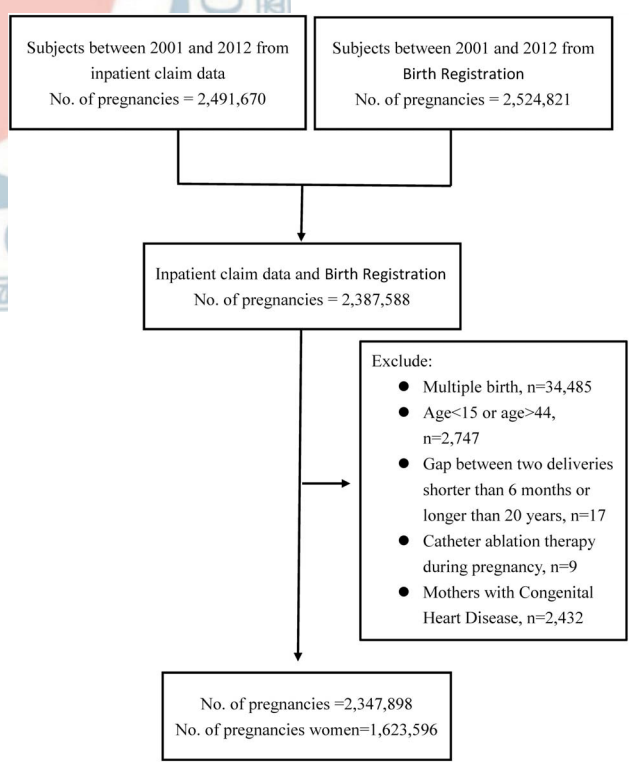


***Figure 1.*** *Flowchart of the study.*

**Table 1.** Basic characteristics of study population

| | Pregnant Women, No. (%) | | |
|---|---|---|---|
| | Pregnancies without PSVT history (n = 2,344,883) | Pregnancies with PSVT history (n = 3,015) | p value |
| Age at pregnancy, mean (SD), y | 29.43 (4.87) | 29.90 (4.80) | < .0001 |
| Male infant | 1,224,339 (52.21) | 1,583 (52.50) | 0.7004 |
| Foreign nationals, No. (%) | 155,184 (6.62) | 26 (0.86) | < .0001 |
| Myocardial infarction | 6 (0.00) | < 3 | < .0001 |
| Congestive heart disease | 75 (0.00) | 34 (1.13) | < .0001 |
| Peripheral vascular disease | 38 (0.00) | 8 (0.27) | < .0001 |
| Cerebrovascular disease | 47 (0.00) | 9 (0.30) | < .0001 |
| Dementia | 6 (0.00) | 0 (0) | N/A |
| Chronic pulmonary disease | 355 (0.02) | 68 (2.26) | < .0001 |
| Connective tissue disease | 265 (0.01) | 35 (1.16) | < .0001 |
| Peptic ulcer disease | 521 (0.02) | 98 (3.25) | < .0001 |
| Mild liver disease | 118 (0.01) | 15 (0.50) | < .0001 |
| Diabetes mellitus | 176 (0.01) | 41 (1.36) | < .0001 |
| Diabetes with complications | 48 (0.00) | 13 (0.43) | < .0001 |
| Hemiplegia and paraplegia | 15 (0.00) | 0 (0) | N/A |
| Renal disease | 22 (0.00) | 3 (0.10) | < .0001 |
| Any malignancy including leukaemia and lymphoma | 33 (0.00) | 8 (0.27) | < .0001 |
| Moderate or severe liver disease | 3 (0.00) | 0 (0) | N/A |
| Metastatic tumour | 4 (0.00) | 0 (0) | N/A |
| Human immunodeficiency virus infection | 4 (0.00) | < 3 | < .0001 |

Numbers < 3 are not displayed. PSVT, paroxysmal supraventricular tachycardia.

respectively, compared to 5625, 9525, and 11526 per 100,000 pregnancies in the PSVT group, respectively. The incidence peaked during the third trimester and declined after delivery in both groups (Figure 2).

When a symptomatic PSVT episode was defined according to the prescription of adenosine, the trend in incidence was different. In the non-PSVT group, the incidence rates of symptomatic PSVT were 12, 31, and 17 per 100,000 pregnancies during the first, second, and third trimester, respectively, compared to 4182, 8371, and 1717 per 100,000 pregnancies in the PSVT group, respectively. The incidence peaked during the second trimester, and rapidly declined during the third trimester (Figure 3).

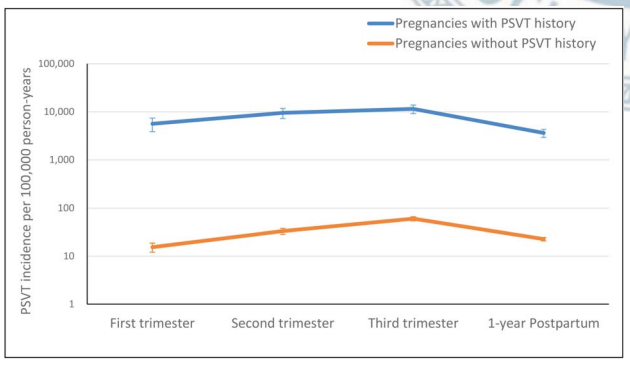


***Figure 2.*** *Incidence of PSVT from the onset of pregnancy to 1-year postpartum. Blue line: Incidence in pregnancies with no history of PSVT (non-PSVT group). Orange line: Incidence in pregnancies with a history of PSVT (PSVT group). The patients in the PSVT group had a higher risk of symptomatic recurrence during pregnancy. The difference persisted from the onset of pregnancy to 1-year postpartum. The trend peaked during the third trimester in both groups. PSVT, paroxysmal supraventricular tachycardia.*

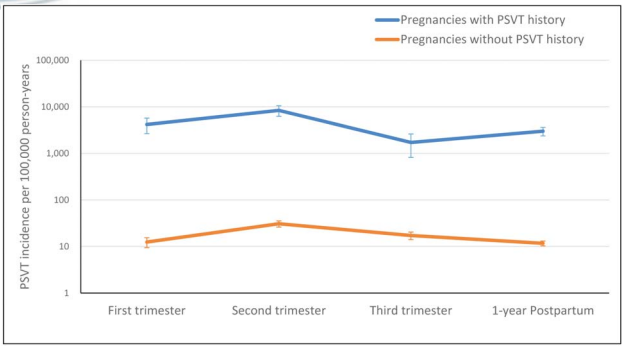


***Figure 3.*** *Adenosine prescription as a priori sensitivity test. Blue line: Incidence in pregnancies with no history of PSVT (non-PSVT group). Orange line: Incidence in pregnancies with a history of PSVT (PSVT group). The trend peaked during the second trimester in both groups. PSVT, paroxysmal supraventricular tachycardia.*

## DISCUSSION

There are two major findings to this population-based cohort study: (i) the incidence of symptomatic PSVT during pregnancy peaked during the third trimester, and (ii) pregnant women with a history of PSVT had a much higher risk of PSVT episodes in the current pregnancy than those with no history of PSVT.

The overall incidence of 33 symptomatic PSVT events per 100,000 pregnancies for the entire population of Taiwan is higher than previously estimated. Li et al. analyzed 136,000 pregnancy-related admissions in a single center and reported 24 PSVT events per 100,000 pregnancies.[10] The authors also indicated that most PSVT events occurred during the final trimester, although they did not offer supporting evidence. In the current study, we compared the incidence of symptomatic PSVT events during each trimester and confirmed that the risk of PSVT during the third trimester was approximately three-fold higher than that during the first trimester. Some reports have suggested an increased incidence of PSVT during pregnancy without indicating the magnitude of the increase,[4,11,12] and our study is the first to estimate the magnitude of the increased risk of PSVT during the third trimester.

In the a priori sensitivity test, the incidence peaked during the second trimester. There are two possible hypotheses for this discrepancy. First, pregnant women in their third trimester may have avoided injected medications due to concerns about potential side effects. Second, they may have preferred other medications such as beta-adrenergic receptors or calcium-channel blockers to adenosine. This discrepancy may imply that women with PSVT tended not to receive adenosine as the first-line treatment during their third trimester, but it may not represent the true incidence.

Pregnant women undergo considerable physiological changes, and plasma concentrations of estrogen and progesterone change during the course of pregnancy. Moreover, the renin-angiotensin-aldosterone system has been reported to be activated during pregnancy.[13] Maternal hormones, particularly estrogen, have been reported to play cardioprotective roles in coronary artery disease,[14] and also to influence the incidence of different types of arrhythmias. For example, women of reproductive age have been shown to have a lower incidence of atrial fibrillation than men.[15] An increasing number of pregnancies have been associated with a higher incidence of atrial fibrillation.[16] The exact mechanism underlying the change in incidence has not been well established, and the different features of the arrhythmia may only partially be explained by maternal hormonal changes.

Few studies have reported the actual incidence of PSVT during pregnancy. In this study, we found an increasing risk of PSVT from the first to third trimesters. This finding may be due to the maternal electrophysiological status and responses to endogenous catecholamines. Nakagaki et al. analyzed autonomic nervous system responses to exercise programs in pregnant women at different gestational ages,[17] and found that the women had higher sympathetic responses in their third trimester than in their second trimester, implying that pregnant women may have a more exaggerated sympathetic feedback to physiological stress. Moreover, pregnant women in their third trimester had a higher resting heart rate and more frequent premature complexes,[3] an environment in which PSVT could occur.

We previously reported that the incidence of symptomatic PSVT during pregnancy was associated with adverse obstetric and fetal events,[8] and PSVT during pregnancy may not be as benign as previously believed. Our findings highlight that clinicians should be aware of the higher risk of recurrence of PSVT in this specific population. Understanding the pattern of incidence during pregnancy may help physicians to improve maternal and fetal outcomes. The NHIRD is a large population-based single dataset that covers the entire population of Taiwan. It prospectively recorded PSVT events in 3,015 pregnancies, which represents the largest sample regarding PSVT in pregnancy. In addition, the universal health insurance coverage minimizes the possibility of underestimating symptomatic PSVT events. Considering safety and ethics issues, it is reasonable to use retrospective studies with well-built databases for pregnant women. However, prospective studies and registry-based programs are needed to confirm our findings.[22]

In our previous study, we found that pregnant women who had previously received catheter ablation had a lower incidence of symptomatic PSVT.[8] However, it is unclear whether cardiac ablation for PSVT is appropriate during pregnancy. Several studies have reported catheter

ablation in pregnant women, most of which have been case reports.[23-25] Minimizing radiation exposure and ensuring safety are important concerns. Cryoablation has been increasingly used in pediatric patients,[26] and its application can be expected in pregnant women in the future.

There are several limitations to this study. First, some quantitative parameters such as the concentration of blood hemoglobin or thyroid-stimulating hormone were unavailable in the NHIRD, and this may have affected the results. Second, the sensitivity test we used to identify and analyze PSVT was prescriptions of adenosine, and medications other than adenosine such as beta-adrenergic receptors and calcium-channel blockers were not analyzed. However, although beta-adrenergic receptors and calcium-channel blockers are recommended by guidelines for the treatment of PSVT, they could also be prescribed for hypertension or other types of arrhythmia during pregnancy.[18-21] Therefore, they were not appropriate for sensitivity testing. Third, the subtypes of PSVT such as Wolff-Parkinson-White syndrome and atrioventricular nodal reentrant tachycardia were not further differentiated. Fourth, we could only identify substantial symptomatic PSVT episodes. Women with minor or no symptoms may have visited outpatient departments or clinics and may not have been enrolled in this study. Therefore, the actual number of symptomatic PSVT episodes may have been underestimated.

## CONCLUSIONS

Pregnancy was associated with a substantially higher risk of symptomatic PSVT, and the incidence peaked during the third trimester. Previous symptomatic attacks resulted in a much higher risk of recurrent PSVT during pregnancy. We suggest that clinicians should be aware of this trend. Prompt management of PSVT events may prevent maternal and fetal complications.

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## CONFLICT OF INTEREST

All the authors declare no conflict of interest.

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