Kinetic profile of arrhythmia in pregnant women with cardiovascular diseases in different cardiac risk according to modified WHO classification: an observational study

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Abstract

Objective: To describe the kinetic profile of arrhythmia in pregnant women with heart diseases in different cardiovascular risk according to mWHO classification. Design: Prospective observational study Setting: Cardiac and Vascular Diseases, Institute of Cardiology, CMUJ, John Paul II Hospital, Krakow, Poland Population: 103 pregnant women with organic heart disease(HD) Methods: 24-hour ECG-Holter was obtained in each trimester of pregnancy and post-partum period Main outcome measures: Supraventricular arrhythmia(SA): supraventricular tachycardia (SVT), supraventricular extrasystole (significant when SVE >30/hour), atrial tachycardia (AT), atrial fibrillation (AF);Ventricular arrhythmia(VA): ventricular premature contractions (PVCs >30/h), non-sustained, sustained tachycardia (nsVT, sVT);Conduction disturbances: low grade: AV I degree block, Mobitz I, high grade: Mobitz II,III degree blocks. Results: The prevalence of arrhythmia was 45.6 % of women, SA occured in 24.3 % and VA in 31.1%. Episodes of nsVT were more common in women with serious HD (mWHO class II-II, III, IV) than in women with milder HD (mWHO I, II) in each trimester: trimester1: 1,7% vs. 13,6%, p=0,02; trimester2: 5,1% vs. 18,2%, p=0,03; trimester3: 2,3% vs. 13,9 %, p=0,04,respectively.The kinetic profile of arrhythmia throughout pregnancy was different among groups: ventricular arrhythmia had tendency to increase in both groups, supraventricular arrhythmia declined in women with milder CHD and increased in serious CHD group. The highest rate of arrhythmia was in the 2nd trimester in both groups (29,2%). Conclusion: The kinetic profile of arrhythmia during pregnancy was different between groups with lower and higher cardiac risk, with more favorable profile in lower cardiac risk group. Keywords: Arrhythmia, Cardiovascular disease, Pregnanc

Methods

Study population. The study cohort consisted of 103 consecutive pregnancies in women with various established heart diseases, including corrected and uncorrected CHDs, cardiomyopathies, connective tissue diseases, and arrhythmias, who were referred to the ambulatory and dedicated cardiac care unit during their first trimester of pregnancy (1-12 weeks). All women underwent cardiac assessment at baseline and at least once per trimester (trimester 2: 13-24 weeks; trimester 3: 25-37 (40) weeks of gestation) and 6 months postpartum. Pregnancies ending in a miscarriage (fetal death at <20 weeks of gestation) were excluded. All women were classified by mWHO class based on their underlying heart condition. In line with landmark studies, if the woman presented with more than one diagnosis, the one of highest severity was selected for classification. Pregnancies were divided into two groups according to their cardiac event rate as: a lower risk one(group 1, 2.5-10.5%) consisting of women in mWHO classes I and II, and a higher risk one (group 2, 10-100%) comprised of women in mWHO classes II-III, III and IV. The study was approved by the local Bioethical Committee and the entire cohort of women gave fully informed written consent.

Examinations

Clinical data, including age, New York Heart Association (NYHA) functional class, parity, type of cardiac disease, prior cardiac surgery and implantation of any devices, were collected at baseline. All patients had basic laboratory tests, serum electrolytes, blood morphology and TSH assessed.

Transthoracic Echocardiography was performed on a commercially available apparatus (Vivid 7 GE Medical System, Horten, Norway). Standard projections and measurements were obtained by adhering to the recommendations of the European Association of Cardiovascular imaging(EACVI). The left (systemic) and right ventricular diameters (LVDd, LVSd, RVD1-3), left ventricular ejection fraction (EF), tricuspid annular plane systolic excursion (TAPSE), and Doppler quantification of valvular regurgitation were assessed.

24-hour ECG Holter monitoring (Lifecard CF, Spacelabs Healthcare, Snoqualmie, WA, USA) was performed four times –in each trimester and postpartum. Three channel leads were placed at locations V1, V3, and V5. The 3-lead ECGs was recorded with the standard setting of 25mm/s. Standardized definitions of cardiac arrhythmias were applied in accordance with the current EHRA/HRS/APHRS Expert Consensus statement11Pedersen CT, Kay GN, Kalman J, Borggrefe M, Della-Bella P, Dickfeld T et al. EHRA/HRS/APHRS expert consensus on ventricular arrhythmias. Europace. 2014 Sep; 16(9): 1257-83..Recordings categorized as **ventricular arrhythmia** were: premature ventricular contractions (PVCs), considered significant when >30/per hour (>720 per 24 hours)22Al-Khatib SM, Stevenson WG, Ackerman MJ, Bryant WJ, Callans DJ, Curtis AB et al. 2017 AHA/ACC/HRS guideline for management of patients with ventricular arrhythmias and the prevention of sudden cardiac death: Executive summary: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines and the Heart Rhythm Society. Heart Rhythm. 2018 Oct; 15(10): e190-e252.; non-sustained ventricular tachycardia (nsVT), defined as three or more consecutive ventricular beats at a rate of >100bpm, lasting for <30 seconds; and sustained ventricular tachycardia (sVT) – lasting for more than 30 seconds. **Supraventricular arrhythmia** referred to episodes of supraventricular tachycardia (SVT) or supraventricular extrasystole (SVE) –considered significant when >30 per hour (>720 per 24 hours), atrial tachycardia (AT) and atrial fibrillation (AF). **Conduction disturbances** were categorized into clinically reasonable divisions:"low grade" AV block (including: AV first degree block and Mobitz I block) and "high grade" AV block(Mobitz II block or 2:1,and III degree AV block)33Dhingra RC, Denes P, Wu D, Chuquimia R, Rosen KM. The significance of second degree atrioventricular block and bundle branch block. Observations regarding site and type of block. Circulation. 1974; 49: 638–46.

Statistical analyses

Statistical analysis was performed using the Statistica PL software [Dell Inc. (2016), Dell Statistica (data analysis software system), version 13; software.dell.com] and MedCalc Statistical software version 16.8 (MedCalc software bvba, Ostend, Belgium; https://www.medcalc.org; 2016). The significance level was set at an alpha level of 0.05. In both groups, continuous data were compared with the Student t-test or Mann–Whitney U test when appropriate. The χ2-test was used to compare categorical variables. Values were expressed as a range, average with SD, or number (%).

Results

Baseline characteristics

The baseline characteristics of the study population are presented in Table 1.Group 1 consists of 60 women (58.3%) in mWHO class I (35, 33.9%) and II (25, 24.3%), whereas group 2 consists of 43 women (41.7%) in mWHO class II-III (14, 13.6%), III (24, 23.3%) and IV (5, 4.8%). Table 1B (supplementary) presents heart disease diagnoses. There were 98 (95.1%) singletons and 5 (4.9%) twin pregnancies. At the baseline all women were in NYHA classes I and II, there were in optimal hemodynamic alignment. There was no difference in terms of age between the groups (group 1 – 30.3±5.4 vs. group 2 – 30.7±5.9 years; p=0.68),or in terms of the number of prior miscarriages between group 1(12, 20.3%) vs. group 2(7, 15.9%). More women in group 2 were nulliparous (70.4% vs. 45.8%; p=0.012) and had undergone cardiac surgery before pregnancy

(41.7% vs.11.9%; p<0.001).There were no differences in the prevalence of hypertension and diabetes mellitus, but more women in group 1 declared a smoking habit. Baseline echocardiographic parameters revealed a significantly higher left ventricular ejection fraction (LV-EF) in group 1 [67% (63-70) vs. 62% (58-66), p<0.01)], and smaller right ventricular diameter (RVd) [group 1 – 26 (23-29) vs.29 (28.5-31.5) mm; p<0.05]. There were no differences in baseline laboratory parameters, including those for hemoglobin, sodium and potassium levels, between the groups. We identified 17 women who had arrhythmia before their pregnancy: 2 following ablation due to PVCs, 1 following ablation due to atrio-ventricular nodal reciprocating tachycardia (AVNRT), 2 with an implantable cardioverter-defibrillator (ICD)(one as a secondary preventive measure), 2 with a high-grade AV block following pacemaker implantation, 1 with episodes of nsVT, and 16 with episodes of SVT.

Arrhythmias

In the study population, the prevalence of any kind of arrhythmia was present in 47 (45.6%) women (Table 2). Heart rate frequency gradually increased during pregnancy in both groups, reaching the highest value within the third trimester. Initial value of average and maximal heart rate were higher among women in the first group than in the second group and that difference remained during second trimester. Supraventricular arrhythmia occurred in nearly one-quarter (25; 24.3 %) of all pregnancies: SVT occurred in 12 (11.7%), SVE >720/24 hour in 18 (17.5%), AF in 1 (0.97%), and AT in 2 (1.9%). Ventricular arrhythmia was recorded in almost one-third (32; 31.1%) of women: nsVT in 17 (16.5%), sVT in 2 (1.9%) and, PVCs>720/24 hour in 22 (22.4%). There were no differences in the prevalence of most types of arrhythmias between the groups, except for nsVT episodes, which were more common in group 2.

Kinetic profile of arrhythmia throughout trimesters

In group 1, the prevalence of supraventricular arrhythmias (SVT and SVE >30/hour) declined on transitioning from the 1stto the 2ndtrimester,and later remained at the same level throughout the third trimester. In contrast, the frequency of ventricular arrhythmias (nsVT and PVCs>30/hour)rose from the 1st to the 2nd trimester, but then stayed steady during the last trimester. Generally, postpartum, the incidence of arrhythmia did not differ significantly or even increase in comparison to the third trimester in the first group (Table 2). Figure S1 shows graphical presentation of kinetics in group 1. In group 2, the prevalence of supraventricular arrhythmia remained constant, whereas the frequency of ventricular arrhythmia increased from the1st to the 2ndtrimester. Thereafter, the numbers for both SVE>30/h and PVCs >30/h decreased, whereas episodes of nsVT and sVT continued at the same level during the last trimester (Table 3). Figure S2 shows graphical presentation of kinetics in group 2. Based on the entire tranche of data, the highest rate of cardiac arrhythmia was recorded in the second trimester in both groups. As for conduction disturbances, only one woman from group 2 experienced asymptomatic episodes of advanced AV block (2:1) at night. Pregnancies in women with implanted pacemaker were uneventful.

Comparisons of the dynamics of arrhythmia throughout trimesters and postpartum between women from group 1 and 2 are presented in Table 4. To save space, the corresponding values of each parameter were not reiterated since they have already been presented in detail (Tables 2 and 3). As shown, only prevalence of nsVT was significantly higher in the group 2 (higher mWHO classes) in comparison to group 1, whereas the prevalence of all other arrhythmia types and conduction disturbances were similar in both groups.

Discussion

Prevalence of arrhythmia during pregnancy

For numerous reasons, including increased hemodynamic burden, neuro-hormonal activation, and psychological factors (stress, anxiety), an increase in the frequency of benign arrhythmias (e.g. PVCs, short runs of SVT, etc.), even in otherwise healthy pregnant women, is to be anticipated. These same conditions apply to pregnant women with the pre-existing cardiac disorders that fall into the mWHO classification system. Thus, the issue of arrhythmias during pregnancy, particularly in women with various cardiac conditions, is of great clinical importance. In terms of diagnostic modalities, arrhythmias can be explored by various means:

via history (clinical symptoms), resting ECG, 24-48 hour Holter monitoring or event loop recorders (ERT). Clearly, the chosen diagnostic method will determine the specific measurement outcomes, which in this case is the type and frequency of reported arrhythmias. Consequently, our knowledge of the true incidence of arrhythmias in pregnant women in various mWHO classes is at present only fragmentary. To date, there have been two types of study that have explored this issue: large multi-center registries and small single-center studies; both have their limitations. Although registries recruit a large number of women (in the thousands or more), diagnostic methods rely on gathering data on patient history (self-reported, investigator-reported symptoms)and 12-lead ECG, at best. In contrast, smaller studies utilize more accurate diagnostic methods, particularly Holter monitoring. As a result, large registers, such as ROPAC, CARPREG or ZAHRA, which were performed in women in various mWHO classes, report a much rarer frequency of arrhythmia than single-center studies do. According to the latest prospective ROPAC registry, which involved 5739 CHD pregnant women, arrhythmias were diagnosed based on resting ECG and/or reported clinical data from a single period of pregnancy11Roos-Hesselink J, Baris L, Johnson M, De Backer J, Otto C, Marelli A et al. Pregnancy outcomes in women with cardiovascular disease: evolving trends over 10 years in the ESC Registry Of Pregnancy And Cardiac disease (ROPAC). Eur Heart J. 2019 Dec 14; 40(47): 3848-3855.. The prevalence of arrhythmia reported in the ROPAC registry, at a level of 2%, referred mostly to symptomatic episodes22Ertekin E, van Hagen IM, Salam AM Ruys TP, Johnson MR, Popelova J et al. Ventricular tachyarrhythmia during pregnancy in women with heart disease: Data from the ROPAC, a registry from the European Society of Cardiology. Int J Cardiol. 2016 Oct 1; 220: 131-6. We might therefore justifiably assume that this number represents an underestimation of the actual incidence of heart rate abnormalities in the population. Another multicenter analysis, the CARPREG II study, in which arrhythmia was found to occur in 9.3% of pregnancies, also used resting ECG, but repeated this in subsequent trimesters and in postpartum33Candice K, Silversides MD, Jasmine Grewal MD, Mathew Sermer , Marla Kiess , Valerie Rychel et al. Pregnancy outcomes in women with heart disease: The CARPREG II Study. J AM Cardiol. 2018 May 29; 71(21): 2419-2430. This slightly increased the threshold of arrhythmia diagnoses. Using a different approach, in a retrospective analysis conducted by ZAHARA investigators, the incidence of rhythm disturbances was based on reported medical records and used ICD-9 classification44Drenthen W, Boresma E, Balci A, Moons P, Roos-Hesselink JW, Mulder BJ et al. Predictors of pregnancy complications in women with congenital heart disease. Eur Heart J 2010 31, 2124-2132. However, the clinical data was collected during single and multiple stages of pregnancy, and did not provide any information regarding the manner in which the symptoms of arrhythmia were verified. Presumably, the reported ratio of heart rhythm abnormalities (in this analysis, at a level of 4.7%) concerned only symptomatic episodes.

More accurate diagnostics, such as Holter monitoring or ERTs, with dedicated analyses are typically used in smaller scale studies. This gives more accurate estimations of the incidence of arrhythmia in the populations under study. As cardiac arrhythmias can be identified on Holter recordings in up to 60% of normal people under the age of 40 years its is not surprising that ectopic beats and non-sustained arrhythmias are encountered in more than 50% of pregnant women investigated for palpitation55Adamson DL, Nelson-Piercy. Managing palpitations and arrhythmias during pregnancy. Heart. 2007 Dec; 93(12): 1630-6. Cruze et al. recorded heart rhythms among pregnant women who reported heart palpitations, using one of three methods: resting ECG, 24-48 hour Holter, or with the ERTs system66Cruz MO, Hibbard JU, Alexander T , Briller J. Ambulatory arrhythmia monitoring in pregnant patients with palpitations. Am J Perinatol. 2013 Jan; 30(1): 53-8.. In this study, arrhythmia was confirmed in up to 76% of women (73 women), and ERTs displayed the greatest diagnostic accuracy. In another study, Niwa et al., who performed 24-hour Holterin the28thweek of pregnancy in women with CHD, found that 56-59% of them had arrhythmias, mostly benign77Niwa K, Tateno S, Akagi T, Himeno W, Kawasoe Y, Tatebe S et al. Arrhythmia and reduced heart rate variability during pregnancy in women with congenital heart disease and previous reparative surgery.Int J Cardiol. 2007 Nov 15; 122(2): 143-8. In addition, Choi and colleagues observed arrhythmias in 22% of women using 24-hour Holter88Choi H S, Han S S, Choi H A, Kim H S, Lee C G, Kim Y Y et al. Dyspnea and palpitation during pregnancy. Korean J Intern Med. 2001 Dec; 16(4): 247-9. Thus, the frequency of arrhythmias in our study, at 45%, is at a comparable level to similar studies with more accurate diagnostic methods (e.g. longer periods of rhythm monitoring), and much higher than in the large-scale registries.

Interestingly, supraventricular arrhythmia occurred in almost one-quarter (24.3%) of women, whereas ventricular arrhythmia happened in just under one-third (31.1%). This is a novel observation since supraventricular arrhythmia is considered to be more prevalent during pregnancy while ventricular tachyarrhythmia occured only in small percentage of cases99Tateno S, Niwa K, Nakazawa M, Akagi T, Shinohara T, Yasuda T; Study Group for Arrhythmia Late after Surgery for Congenital Heart Disease (ALTAS-CHD). et al. Arrhythmia and conduction disturbances in patients with congenital heart disease during pregnancy: multicenter study. Circ J. 2003; 67(12): 992-7. Vaidya et al. reported that supraventricular arrhythmia constituted the main reason for hospital admissions among pregnant women, with a prevalence of 53 per 100,000 admissions, while ventricular arrhythmia was noted in 18 per 100,000 admissions1010Vaidya VR, Arora S, Patel N, Apurva O Badheka A O, Patel N, Kanishk Agnihotri K et al. Burden of arrhythmia in pregnancy. Circulation. 2017 Feb 7; 135(6): 619-621. Moreover, Li et al. confirmed that episodes of SVT were the most common arrhythmia, along with PVCs and SVE, in a high-volume and ethnically diverse obstetric service1111Li JM, Nguyen C, Joglar JA, Mohamed H Hamdan, Richard L Pageet al. Frequency outcome of arrhythmias complicating admission during pregnancy:experience from a high-volume and ethnically-diverse obstetric service. ClinCardiol, 2008; 31: 358-541. It is worth remarking that episodes of SVT in our study are at similar levels to those found in the literature. Conversely, one of the most recent pieces of research conducted on a high-volume pregnancy group (3.6 million hospitalizations over 7 years) revealed that serious ventricular arrhythmia, including episodes of nsVT and sVT, dominated in pregnant women with complex CHD1212Hayward RM, Foster E, Tseng ZH. Maternal and Fetal Outcomes of Admission for Delivery in Women With Congenital Heart Disease. JAMA Cardiol. 2017 Jun 1; 2(6): 664-671.. This observation is in line with our findings, as we observed that episodes of nsVT and sVT occurred more often in group 2 (i.e. more advanced mWHO classes). This observation indicates that pregnant women, particularly those with complex CHD, are susceptible to serious ventricular arrhythmia from the beginning of gestation. They should be monitored carefully to minimize the risk of potentially life threatening rhythm disturbances.

Pregnancies in women with implanted pacemaker due to congenital high-grade AV block and with an ICD were uneventful what was also confirmed in previous reports1313Thaman R, Curtis S, Faganello G, Szantho G V, Turner M S, Trinder J et al. Cardiac outcome of pregnancy in women with a pacemaker and women with untreated atrioventricular conduction block. EP Europace, Volume 13, Issue 6, June 2011, Pages 859–863.,1414Kutarski A, Polewczyk A. Sinus node disease and atrio-ventricular disorders in pregnant women. When temporary or permanent pacing is necessary. Przegl Lek. 2015;72(4):205-8,1515Hidaka N, Chiba Y, Kurita T, Satoh S, Nakano H. Is intrapartum temporary pacing required for women with complete atrioventricular block? An analysis of seven cases. BJOG. 2006 May;113(5):605-7.

Kinetic of arrhythmia throughout the trimesters

Surprisingly, the variability of arrhythmia during pregnancy has thus far been poorly explored. There is a distinct shortage of prospectively conducted analyses with serial 24-hour Holter monitoring in each trimester, and postpartum, in the available literature. One of the studies that addressed the dynamics profile of arrhythmia during pregnancy was CARPREG II[10]. The authors noticed that rhythm abnormalities had a tendency to increase during pregnancy with the highest frequency being detected in the second trimester. However, no serial 24-hour Holter monitoring was performed; instead, resting ECG was conducted in each trimester and postpartum. Additionally, no attempt was made to distinguish the dynamics of supraventricular and ventricular arrhythmia as part of the analysis. In this study, we describe the dynamics profile of arrhythmia in women in various risk based on the mWHO. Firstly, we noticed changes in basic rhythm parameters with systematic increases in heart rate frequency throughout the trimesters, which is in keeping with the previously described natural hemodynamic adaptation to gestation. However, these changes were more pronounced in women with lower cardiac risk ratios (mWHO class I-II), most likely due to the greater susceptibility to physiological increases in autonomic activity during pregnancy and reduced heart rate variability in women with congenital heart disease and previous reparative surgery11McGlone L, Patel N, Young D, Danton MD. Impaired cardiac autonomic nervous control after cardiac bypass surgery for congenital heart disease. Interact Cardiovasc Thorac Surg. 2009 Aug; 9(2): 218-22. . It is worth noting that women with milder heart disease were initially characterized by higher heart rate. Based on the analysis carried out,

the prevalence of ventricular arrhythmia had a tendency to increase regardless of the mWHO class, while supraventricular arrhythmia trended differently: it rose in the second group and declined in the first group.

Here we should make clear that the description of the dynamics given above is somewhat of a generalization because not all subtypes of arrhythmia behaved similarly. To be more precise, pregnant women with serious structural heart diseases (class II-III, III or IV)displayed an increased incidence of supraventricular and ventriculara rrhythmia during pregnancy while women with milder heart diseases (class I and II) had a more favorable arrhythmia profile. This may indicate that women with complex heart defects are more at risk of experiencing arrhythmias than women with milder heart diseases. Intriguingly, supraventricular and ventricular arrhythmia reacted differently to the treatment applied during pregnancy, with a better response observed for supraventricular arrhythmia in women with milder heart diseases, or in those without structural heart defects. We also noticed that overall rates of arrhythmia were highest in the second trimester, which mirrors the CARPREG study. This pronounced increase in the frequency of arrhythmia in the second trimester may indicate that rhythm abnormalities accelerate earlier than the peak of hemodynamic overload, which takes place in the last trimester. While some authors have similarly observed that arrhythmia occurs most frequently in the second trimester[10], others have found the third trimester to be the most arrhythmogenic period. Li et al. observed that the majority of arrhythmia happened in the third trimester and during the first days following delivery,(although they lacked data for each trimester)[18].

Regarding the postpartum, this period is characterized by a similar prevalence of arrhythmia as in the third trimester; some types of rhythm abnormalities (PVCs, SVE and SVT) were even seen to increase in that period, possibly owing to volume shifts, lower vascular resistance and hormonal influences.

Study limitations

This study was a single center observation which included 103 CHD patients in pregnancy and this may constitute a positive bias for the evaluation of the incidence of arrhythmia in this condition. The number of patients in our group was relatively small, so it is possible that the significance of the prevalence of arrhythmia and the kinetic profile described during pregnancy in this condition may be small. The variability of heart rate abnormalities throughout the trimesters reflects approaches to the treatment of arrhythmia on the part of cardiologists within a single institution, and this may also interact with assessment objectivity.

Conclusions

In women in lower mWHO classes, there was a tendency towards a drop in the frequency of supraventricular arrhythmias, and an early and sustained increase in ventricular arrhythmias during the course of a pregnancy. In contrast, among women in higher mWHO classes, there is a clear trend towards an increase in frequency followed by a plateauing of both supraventricular and ventricular arrhythmias during pregnancy. This study demonstrated that pregnant women with heart disease remain at risk not just at the time of delivery but also before the peripartum period. The prevalence of nsVT was more frequent in each trimester among women in higher mWHO classes, whereas all other remaining arrhythmias were similar in both groups. The role of serial Holter monitoring during the course of pregnancy, particularly in women with more advanced baseline cardiac diseases, should be verified in larger studies.

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Disclosure of interests

None

Contribution to Autorship:

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A. Leśniak -Sobelga- planning, carrying out,

P. Rubiś- planning, conception, analysing

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Details of Ethical approval

The study was approved by the local Bioethical Committee for Collegium Medicum of Jagiellonian University in Cracow, reference number: 122.6120.192.2016. The data of approval was 10. October 2016.

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None

Figure legend

Fifure S1. Kinetics of arrhythmia in pregnant women in mWHO class I and II

Figure S2. Kinetics of arrhythmia in pregnant women with mWHO class II-III, III and IV

References:

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Table 1 General characteristics of the population.docx available at https://authorea.com/users/324356/articles/452584-kinetic-profile-of-arrhythmia-in-pregnant-women-with-cardiovascular-diseases-in-different-cardiac-risk-according-to-modified-who-classification-an-observational-study

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Table 2. Kinetic profile of arrhythmia in group 1.docx available at https://authorea.com/users/324356/articles/452584-kinetic-profile-of-arrhythmia-in-pregnant-women-with-cardiovascular-diseases-in-different-cardiac-risk-according-to-modified-who-classification-an-observational-study

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Table 3 Kinetic profile of arrhythmia in group 2.docx available at https://authorea.com/users/324356/articles/452584-kinetic-profile-of-arrhythmia-in-pregnant-women-with-cardiovascular-diseases-in-different-cardiac-risk-according-to-modified-who-classification-an-observational-study

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Table 4 Comparison of arrhythmia between groups.docx available at https://authorea.com/users/324356/articles/452584-kinetic-profile-of-arrhythmia-in-pregnant-women-with-cardiovascular-diseases-in-different-cardiac-risk-according-to-modified-who-classification-an-observational-study