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Arrhythmias in pregnancy (RCD code: VII-V)

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Abstract

Cardiovascular diseases in pregnancy are the most common causes of maternal mortality in developed world and an important cause of heart failure, stroke, and arrhythmia. Cardiac disease complicates 0.4–4% of all pregnancies, and arrhythmias are among the most common cardiac complications [1]. In some cases, pregnancy triggers exacerbations of pre-existing arrhythmias, whereas in others it may manifest for the first time [2]. A prior history of arrhythmias or structural heart disease and family history of sudden death are the factors that matter to risk of tachyarrhythmias during pregnancy [3]. Due to extraordinary ethical considerations in pregnant women, there are only a few randomized studies and little data on efficacy or safety of antiarrhythmic drugs applied during pregnancy [4]. Therefore, much of clinical care is guided by general knowledge about hemodynamic changes in pregnant women, universal principles of treatment of arrhythmias and finally by gained experience in that area. Multi-disciplinary approach remains the overriding principle in management of pregnant woman with arrhythmias, including collaboration with gynecological and obstetric center. JRCD 2016; 2 (6): 177–180

Key words: electrocardiography, antiarrhythmic drugs, catheter ablation, pacemaker, implantable cardioverter-defibrillator, rare disease

Pathophysiology of arrhythmia during pregnancy

Precise mechanism of increased frequency of arrhythmia in pregnancy remains unclear. There are few components such as hemodynamic, hormonal and autonomic, that are supposed to be responsible for triggering of arrhythmia. Significant hemodynamic changes occurre during pregnancy including increase in effective circulating blood volume up to 30% to 50%, starting at 8 weeks of gestation and reaching peak value at 34 weeks, increase in stroke volume to 35% and heart rate to 15%. Cardiac output is increased with an average of 6,7 l/min in the first trimester and about 8,7 l/min at third trimester [4,5]. As a consequence of increased plasma volume, the stretching of atrial and ventricular myocytes may result in early after depolarization, shortened refractoriness, slowed conduction and spatial dispersion through activation of stretch-activated ion channels [4,6]. These changes may predispose the pregnant women to new-onset arrhythmias.

Additional factors, that contribute to arrhythmogenesis are hormonal and autonomic changes. Both hormones, estradiol and progesterone, elevated during pregnancy, exhibit proarrhythmic effect in animal studies and also in pregnant women [7,8]. Estradiol increases the number of adrenergic receptors in the myocardium [9]. Moreover, a greater sensitivity of adrenergic responsiveness has been observed during pregnancy [10,11].

Standard 12-lead electrocardiogram in pregnancy – physiological changes

Due to enlarging uterus and elevation of the diaphragm the rotation of heart on a long axis in a left-upward direction is observed. That is responsible for shifting the electrical axis to the left. The increase in heart rate which take place during pregnancy may lead to a shortening of the PR, QT intervals and QRS complex duration. Additionally, a small Q wave and/or an inverted T wave may be seen in lead III. [12,13]. Any other abnormalities registered in ECG are pathological and demands further investigations.

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General management of arrhythmias

Therapeutic approach to arrhythmias should be, in general, similar to that in the non-pregnant patient. At first, all potentially modifiable causes of arrhythmias should be excluded such as hyperthyroidism or electrolyte imbalance. According to Food and Drug Administration (FDA) [12] majority of anti-arrhythmic drugs (AAD) are in category C, which means that risk of harmful effect on the fetus cannot be ruled out.

Taking into consideration potential adverse effects on the fetus, treatment should be reserved for symptomatic arrhythmias, which result in hemodynamic disturbances or constitute risk for both mother and for fetus. Another important notice is, that developing fetus is the most sensitive for teratogens during the first trimester when the organogenesis takes place [14]. Therefore initiation of AADs should be postponed – if possible – to the second trimester, and dosing should be at the lowest effective range.

Types of arrhythmias and their management during pregnancy

Palpitations and premature beats are the most common arrhythmias during pregnancy. The prevalence of premature atrial and ventricular contractions in pregnant women without structural heart disease is high reachingover 57% and 50%, respectively [15]. This type of arrhythmia is usually benign and does not require AADs. In patients with intolerable symptoms cardioselective beta-blocker can be started.

Supraventricular tachycardia (SVT) is the most common sustained arrhythmia during pregnancy with a prevalence of 24 per 100 000 hospital admissions [4]. Near 20% of women with pre-existing SVT experience exacerbation of arrhythmia during pregnancy [16]. Paroxysmal SVT in patient without structural heart disease results most commonly from atrioventricular nodal reentrant tachycardia (AVNRT) [2] and in some cases it cause hemodynamic deterioration and impaired fetal blood flow [17,18]. The first step of management pregnant patients with AVNRT is the stimulation of vagal nerve, which can terminate acute episode (class I, level C) [12]. When this maneuver is not effective, adenosine should be applied (class I, level C [12]) as it is safe and can arrest near 90% of the arrhythmias [19]. Immediate electrical cardioversion is recommended for acute treatment of any tachycardia with hemodynamic instability (class I, level C) [12]. The second line drugs which may be useful are intravenous metoprolol or propranolol (class IIa, level C), whereas verapamil is considered a third antiarrhythmic line (class IIb, level C) [12, 20]. For long–term management of AVNRT oral digoxin (class I, level C) or metoprolol (class I, level C) is recommended [12,21]. In cases when episodes of AVNRT are recurrent and symptomatic oral verapamil can be used for prevention of arrhythmia (class IIb, level C) [12]. Oral flecainide or sotalol are reserved for those who did not respond to atrioventricular nodal blocking agents (class II a, level C) [12].For long-term management of SVT, oral propafenone or procainamide may be considered as a last option, if other suggested agents fail and before amiodarone is used (class IIb, level C) [12].

Finally, pregnant women who have drug refractory and hemodynamically significant AVNRT can undergo, but only in special cases, catheter ablation with a low radiation exposure to the fetus [22,23].

The management of the patients with pre-excitation syndrome depends generally on the pathogenesis of tachycardia. Most of them have orthodromic atrioventricular reciprocating tachycardia and a treatment of acute episodes is similar to AVNRT. On the other hand, when accessory pathways are concealed, there are a few drugs which can be used for long-term therapy namely beta-blockers, calcium channel blockers, digoxin or flecainide.

For patients with Wolff-Parkinson-White syndrome class 1 AADs such as flecainide or quinidine should be applied to stop tachycardia, as a result of slowing conduction in accessory pathway. Verapamil or digoxin are contraindicated, because these medications may enhance antegrade conduction through the accessory pathway by increasing the refractory period in the atrioventricular node. In addition, digoxin may shorten refractory period of the accessory pathway, further enhancing its antegrade conduction [20].

Another arrhythmias that can be present during pregnancy is atrial fibrillation (AF) or atrial flutter. These arrhythmias have a prevalence of 2 in 100 000 hospital admissions and mostly are associated with structural heart disease or prior history of AF [16]. Interestinlgy, more than half women with previously diagnosed AF have symptomatic episodes during pregnancy [24]. For patients with hemodynamically unstable episodes electric cardioversion should be applied as a first line treatment. There is no broad experience with pharmacological cardioversion during pregnancy, but there are some reports in literature of using of flecainide and ibutilide [25–27]. Amiodarone, which is in FDA category D (there is positive evidence of risk of harm for the fetus), should be applied only in life-threatening arrhythmias [12]. Cardioversion of atrial flutter and AF, whether electrical or pharmacological require prior, effective anticoagulation and/or transesophageal echocardiographic examination to exclude left atrial thrombus formation. Anticoagulation (warfarin, substituted with UFH or LMWH in the first and last trimester) is considered mandatory for at least 3 weeks before elective cardioversion for AF or atrial flutter of 48 h duration or longer, or when the duration of AF is unknown and should be continued for at least 4 weeks after cardioversion because of the risk of thrombo-embolism.

In majority of cases the goal is to control the rhythm with beta-blockers, calcium channel blockers or digoxin which can be safely used in chronic therapy. Beta-blockers are recommended as the first line therapy while verapamil should be the drug of second choice. Also, there is another option – sotalol and flecainide, when there is difficulty in controlling the rhythm or episodes are poorly tolerated. An important recommendation is a systematic anticoagulation for women with risk factors of thromboembolism.

Ventricular tachycardia (VT) and ventricular fibrillation (VF) are life threatening arrhythmias. Fortunately, its prevalence during pregnancy is rare and constitute 2 in 100 000 hospital admissions [16]. Generally, analogically to AF, VT/VF is usually associated with presence of structural heart disease or with past history of such arrhythmias. Earlier incidences predispose to recurrent arrhythmia and the risk in pregnancy is nearly 27% higher [28].

VT most often occurs in the course of cardiomyopathy including dilated, hypertrophic and arrhythmogenic right ventricular dysplasia [29,30]. Prevalence of such arrhythmias in these patients is relatively high and constitutes of 4.5 to 15.9 per 1000 pregnancies [31]. A separate case is peripartum cardiomyopathy, which symptoms appear during the last trimester of pregnancy or in the first months after delivery. In course of that cardiomyopathy VT or VF may also occur, but their frequency is unknown [32].

Treatment of VT associated with structural heart disease

Treatment of VT depends on patient's hemodynamic condition. In acute cases of sustained monomorphic VT where hemodynamic instability is present direct cardioversion should be applied as soon as possible (class I, level C) [33]. Otherwise, when arrhythmia is well tolerated the pharmacological cardioversion with intravenous sotalol or procainamide should be considered for stable monomorphic sustained VT (class IIa, level C) [33]. Taking into considerationpotential risk of adverse effect to the fetus, intravenous amiodarone should be used only in life-threatening arrhythmias when other therapy has failed (class IIa, level C) [33]. Patients with structural heart disease require chronic anti-arrhythmic therapy with oral beta-blockers such as metoprolol or propranolol (class I, level C) [33]. When these drugs are not effective sotalol, mexiletine and quinidine may be considered as an alternative option. Catheter ablation with the lowest required fluoroscopy and special lead guarding of abdomen is reserved for medically refractory patients with life-threatening arrhythmias (class IIb, level C) [4,33].

The Food and Drug Administration has defined five categories [12] for the use of AADs during pregnancy. According to published guidelines [12, 33] some AADs are classified:

A: controlled studies show no risk (no anti-arrhythmic drug)
B: chance of fetal harm is remote (sotalol, lidocaine)
C: potential benefits outweigh the risk (quinidine, adenosine, metoprolol, propranolol, verapamil, diltiazem, digoxin, flecainide, propafenone)
D: positive evidence of risk (phenytoin, amiodarone)
X: contraindicated.

Treatment of VT without structural heart disease

Idiopathic VT can present for the first time during pregnancy, it is generally hemodynamically stable and associated with good prognosis [34]. In treatment of sustained, hemodynamically tolerated, idiopathic outflow tract VT in the absence of structural heart disease intravenous flecainide or conventional beta-blockers are used with good effectiveness to convert to sinus rhythm (class IIa, level C) [33,35,36]. In fascicular VT non-dihydropyridine calcium-channel blocker such as intravenous verapamil can be used for termination of acute arrhythmia or for prevention of recurrences [33,37].

Pregnant women with long QT syndrome are threatened with malignant arrhythmia more often during the postpartum period than during pregnancy [38]. Based on retrospective study including 422 women with long QT syndrome cardiac events ratio in both groups (40 weeks pregnancy and 40 weeks postpartum period) was 3.8% and 23.4%, respectively. This fact is probably related to the decrease in heart rate, stress and altered sleep patterns during postpartum period. In this group of patients beta-blockers should be included before pregnancy and continued throughout pregnancy and postpartum period (class I, level B) [33]. In women with non -long QT related sustained VT and a stable hemodynamic situation intravenous sotalol acutely can be considered to terminate the tachycardia [12].

Patients with malignant ventricular arrhythmia, who did not respond to pharmacological therapy and are at high risk for sudden cardiac death during pregnancy should be considered as the candidates for cardioverter-defibrillator implantation (ICD) (class I, level C) [33,39]. This procedure must be performed with the lowest required fluoroscopy and with special lead protection of the abdomen. There are some data from the literature about successful ICD implantation guided with echocardiography during pregnancy [36, 40].

Bradyarrhythmias

As concern with bradyarrhythmias in pregnant women the sinus node dysfunction or atrioventricular blocks are rare in this group of patients [41]. Asymptomatic patients with complete heart block especially without structural heart disease have a good prognosis and can be managed expectantly [41]. Recent studies suggest that temporary pacing during labor and delivery is not necessary in stable patients with complete heart block, as it was practiced in the past [42]. On the other hand symptomatic or hemodynamic unstable pregnant women with bradyarrhythmias require permanent pacing. Pacemakers can be safely implanted during pregnancy using low dose of radiation or guided only with transesophageal echocardiography [43,44]. The optimal time of implantation of permanent pacemakers or ICDs (preferably one chamber) is when the fetus is beyond 8 weeks gestation (class IIa, level C)[12].

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