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Electrical and Pharmacological Cardioversion during Pregnancy: Case Series and Literature Review

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Abstract

Cardiac arrhythmias are the most common cardiac complication reported in pregnant women with or without Structural Heart Disease (SHD); however the highest frequency is in women with SHD and Congenital Heart Disease (CHD) that can occur as new disorders or appear as exacerbations in women with this history. They occur frequently during the third trimester or near birth, increasing maternal morbidity and fetal complications. The increase in cardiac volumes and the effects of progesterone are the mechanisms proposed in this increase in the incidence of arrhythmias. In the Canadian study of CARPREG II of a total of 1,938 pregnant women with heart disease, arrhythmia the most frequent cardiac complication occurred in 9.3% followed by heart failure with 6.2% of all pregnancies.

Keywords: Cardioversion and pregnancy; Electrical cardioversion; Pharmacological cardioversion; Atrial fibrillation; Supraventricular tachycardia

Introduction

In women with a history of paroxysmal Supraventricular Tachycardia (SVT), symptoms worsen in the third trimester by up to 85%, even several studies suggest that pregnancy could increase the heart rate of patients with SVT episodes [1-5], Atrial Fibrillation (FA) is currently the most common arrhythmia observed in pregnancy according to Vaidya [6,7], this attributed to increased maternal age, and cardiovascular risk factors [7].

Electrical cardioversion is a therapeutic option when primary measures such as carotid sinus massage, the Valsalva maneuver, or antiarrhythmic therapy have failed (of limited use in pregnancy) and there is hemodynamic instability.

The literature review shows that cardioversion can be safe for both the mother and the fetus; however the published experience limits a case report. The objective of this work is to report the experience in a third-level center in cardioversion during pregnancy in women with hemodynamic compromise, to report the maternal clinical course and the perinatal results obtained. Finally, in refractory cases, ablation can be performed with current techniques in pregnant women with minimal radiation exposure.

Patients and Methods

A search was carried out in the clinical file of the National Institute of Perinatology "Isidro Espinosa de los Reyes" (INPerIER) of Mexico. Women of any gestational age with diagnoses of maternal arrhythmias that require electrical or pharmacological cardioversion due to hemodynamic instability, according to the ICD10 code and who were treated during pregnancy from January 2010 to December 2020. In each case demographic variables were extracted; maternal age, obstetric history, weeks of gestation and cardiovascular medical history. The indications for electrical cardioversion were those recommended by the American Heart Association. Maternal risk was determined according to the modified WHO classification, the CARPREG II classification, and the NYHA. In all cases, the existence of structural heart disease was documented by echocardiography, the cardiological evolution of each patient was carried out by a doctor specializing in cardiology, recording the presence of clinical signs or symptoms of cardiac arrhythmias or changes in cardiac functional class, the evolution of the pregnancy, fetal growth, was performed by the maternal-fetal medicine service of the hospital itself and the fetal response to cardioversion was recorded through the cardiotocographic record, the weeks in which the pregnancy was resolved, the means of resolution, the maternal status and the newborn.

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Measures of mean central tendency and standard deviation were used for the numerical measurements and proportions for the nominal and categorical variables.

Results

Thirteen cases were studied during the 10-year period, of which in 11 cases the complete data from the clinical record was obtained for inclusion in the analysis. The clinical characteristics and demographic data are shown in Table 1. All women were admitted to the Institute through the emergency department with hemodynamic and/or neurological compromise. 57.1% (6 cases) required electrical cardioversion and three cases (42.8%) required pharmacological cardioversion.

In all cases, basic life support measures were implemented, ensuring the airway, and oxygenation in addition to non-invasive monitoring of blood pressure, electrocardiography and pulse oximetry, a cardiotocographic record was installed to detect alterations in fetal well-being and frequencies. Fetal heart rates are seen in the Table. The mean maternal age was 24.3 years, in 57.1% the event occurred in their first gestation, the mean gestational age at the time of admission to the emergency room was 22.6 weeks, and the minimum gestational age was 7 weeks and the maximum at 38.5 weeks. Two cases with Ebstein's anomaly (28.6%) and two with atrial septal defect were observed; in three cases no structural heart disease was identified.

In women who required pharmacological cardioversion, there is structural heart disease in 50% of cases (Ebstein's anomaly, CIA and PCA).

In women who required electrical cardioversion, only in one case was structural cardiac pathology identified due to Ebstein's anomaly.

Maternal hemodynamic status before cardioversion

The symptoms were dyspnea (100%), hypotension (100%), syncope and lipothymias (42.9 %). The mean systolic pressure on admission was 77.8 mmHg; the mean diastolic pressure was 53.8 mmHg. In all cases there was an elevation of blood lactate (>2 mMol/L).

In all cases, carotid massage, Valsalva maneuver and antiarrhythmic drug therapy were indicated and anticoagulation was performed with conventional sodium heparin and/or subcutaneous enoxaparin.

Maternal results

Maternal survival was 100%, there were 5 cases that required more than one shock due to recurrence of cardiac arrhythmia during pregnancy or the puerperium, and however, in 100% of the cases, complete remission was achieved. In four patients there was recurrence of the arrhythmia during pregnancy and in two women in the immediate puerperium. Case 1 with a diagnosis of arrhythmogenic right ventricular dysplasia required electrical cardioversions on 10 occasions throughout the pregnancy (Table 1). The patient with ASD and Ebstein's anomaly (case 3) developed acute pulmonary edema and did not initially respond to pharmacological cardioversion and subsequently required electrical cardioversion in addition to requiring invasive mechanical ventilation. There was an average of 8.6 weeks of pregnancy gain between the time the cardioversion was performed and the resolution of the pregnancy.

Perinatal outcomes

There was a 100% fetal survival, the average gestational age at the time of pregnancy resolution was 37.1 SD ± 1.3 in 85.7% and the route of birth was abdominal. In two cases the indication was due to prematurity secondary to loss of fetal well-being; in all cases there was an Apgar score of 9. After 5 min, the average stay in the intensive care unit before and after cardioversion was 3.3 ± 0.7 days. Case 8 developed Intrauterine Growth Restriction (IUGR) and Preeclampsia (PE) with severity data, case 9 developed IUGR. In both cases, the loss of fetal well-being triggered the resolution of the pregnancy. The loss of fetal well-being was not related to electrical cardioversion.

Discussion

Electrical and/or pharmacological cardioversion during pregnancy is currently recommended by the AHA (Editorial and Article Editorial 2020; Correction to: 2015 ACC/AHA/HRS Guide ...), ESC [8] (Editorial and Article Editorial 2020), ANMCO, SIGO [9]. Before 2011, 44 cases of electrical cardioversion had been reported in the English-language literature (Tromp et al. 2011). The types of arrhythmias in the published cases is very varied and of different etiology, the shock ranges used range from 50 J to 400 J [10] and currently more than 25 cases have been published in recent years. The literature dealing with pharmacological cardioversion in pregnancy is also limited to case reports; a report from a tertiary center in Texas reported a total of 23 SVTT cases [11] and only two with atrial fibrillation. Pharmacological cardioversion is also a safe therapy during pregnancy, there are a great variety of possibilities and

Table 1: Cardiological characteristics of the patients.

Patient	Maternal age	Structural heart disease	Previous arrhythmia	Time of evolution (years)	Treatment antiarrhythmics
1	22	Arrhythmogenic RV dysplasia	TVM	2	None
2	21	No	TSVP reentry intranodal	9	None
3	19	No	TSVP	5	Disopyramide 12.5 mg/12 h
4	23	CIA, Ebstein's Anomaly	TSVP	Current income	Propranolol 20 mg / day
5	29	ASD and radiofrequency atrial ablation	Atrial tachycardia	1	Propafenone 150 Mg and oral anticoagulant
6	25	No	TSVP	First event	Anticoagulation
7	31	Ebstein's anomaly	TSVP	5 years	Disopyramide
8	16	No	TSV reentrada intranodal	3	None
9	28	PCA and CIA corrected	TSV reentrada intranodal	6	Propafenona,metoprolol.
10	37	No	FA	First event	None
11	26	No	TSVP	First event	None

SDG: Weeks of Gestation; SVT: Paroxysmal Supraventricular Tachycardia; PT: Paroxysmal Tachycardia; TVM: Monomorphic Ventricular Tachycardia

Table 2: Clinical characteristics and treatment of arrhythmias.

Patient	Symptoms Initials	TA minimal	FCM máxima	FCF	Cardioversion	Gestational age at cardioversion	Complications	TXM VO
1	Palpitations Diaphoresis Orthopnea Sickness Syncope, dyspnea	75/42	190	145	Electrical (one shock, 100 J)	24.3	No	Sotalol 80 mg / day
2	Palpitations, Dyspnea	100/60	213	158	drug (verapamil, 5 mg IV)	34.4	No	Verapamilo 40 mg/12 hrs
3	Agitation, Dizziness, Dyspnea, Clouding	80/45	230	130	Electrical (4 downloads, minimum dose 50 J, maximum 150 J)	38.5	VM	Propafenone 300 mg / day
4	Palpitations Headache, Dyspnea	100/60	197	147	Drug (verapamil, 5 mg IV)	35.5	Hypotension Persistent	Propranolol 40 mg / day
5	Headache, Dyspnea	100/55	220	140	Drug Verapamil 2 mg IV	7	No	Diltiazem 30mg VO c /8hrs, Propranolol 20mg C/8hrs,
6	Dyspnea, palpitations, syncope	90/60	210	155	Electrical cardioversion	28.3	No	
7	Dysnea, lipotemia, synapse	100/55	205	149	Electrical cardioversion	33.5	No	
8	Dyspnea	70/40	200	132	Electrical cardioversion	26.2	Recurrence	Propafenona/metoprolol
9	Palpitations Dyspnoea	75/60	200	142	Medicines adenosine alsmol	22.2	No	Propafenona y metoprolol
10	Dyspnea, angina	60/40	160	144	Medicines, Digoxin	33.2	No	Propafenona
11	Angina, dyspnea, palpitations	88/50	208	142	Medicines, adenosine	24.1	No	Propafenona

BP: Blood Pressure; FCM: Maximum Heart Rate; FCF: Fetal Heart Rate; TXM: Drug Treatment

Table 3: Gestational age, way of resolution, treatment and stay in ICU.

Patient	SDG	Way of Birth	Weeks post cardio version	Apgar	Definitive treatment	Stay in the ICU
1	38.6	Vaginal	14.3	8/9	Unknown	3
2	38.4	Caesarean section	4	8/9	Ablation	2
3	38.5	Caesarean section	0	9/9	Ablation	4
4	35.5	Caesarean section	0	8/9	Unknown	3
5	35	Caesarean section	28	8/9	Unknown	4
6	37	Caesarean section	8.7	9/9	Ablation	3
7	37	Caesarean section	3.5	8/9	Ablation	4
8	34.2	Caesarean section	8	8/9	Ablation	2
9	31.5	Caesarean section	9	1/2	Unknown	2
10	38.3	Caesarean section	5	8/9	None	2
11	39.2	Vaginal	15	8/9	Ablation	2

SDG: Weeks of Gestation; ICU: Adult Intensive Care Unit

there is greater experience of success with adenosine, it has not been related to fetal malformations, still used in the first trimester.

Uterine muscle and amniotic fluid are excellent electrical conductors, so it is expected that the fetus will also receive the applied shock. Maternal and fetal resistance to electric shocks of any kind has been demonstrated in different settings, Ran D Goldman [12,13] reported a case of a pregnant woman who received an electric shock and a cohort study published by Motherisk Program [14] demonstrated that home electric shocks have no immediate fetal effects.

Maternal outcomes

Maternal survival in all publications for electrical cardioversion is 100%. The frequency of, similar to that observed in our cases, in all cases a mixed therapy was used, vagal maneuvers were started, subsequently pharmacological and finally electrical cardioversion; which shows that the implementation of these measures are safe in pregnancy. However, in the cases we publish, the women came to the emergency department with neurological symptoms such as syncope or lipothymias; and/or hemodynamic compromise, finding varying degrees of arterial hypotension in all cases. In 4 cases this sequence was not performed and shock was the second therapeutic measure as it did not respond to vagal maneuvers due to hemodynamic compromise. The mean systolic pressure in our cases was 77.8 mmHg and 53.8 mmHg in the diastolic, in contrast to what was observed in the publications, which was 104.6 mmHg in the systolic and 68 mmHg. This characteristic was observed in 3 out of 7 cases, we pointed out this situation to indicate that even in critical states, cardioversion is a beneficial treatment measure and that it should be performed when the primary measures are not effective or there is hemodynamic compromise.

Evidence based on case series shows no risk of fetal death or malformations. Case number 5 in our series, the patient with the lowest gestational age observed, was reversed with drugs with an acceptable perinatal result. The need for repeated shocks during pregnancy is likely to present few fetal effects, as demonstrated in our case number 1 with arrhythmogenic dysplasia in which 10 shocks were performed from week 10 of pregnancy until its resolution at term with a newborn healthy, case number 8 received three shocks upon admission to the emergency room, however, the poor perinatal outcome seems more associated with preeclampsia and IUGR. Tromp published a case of a 29-year-old woman with 34 weeks of gestation

Table 4: Treatment of complications and recurrences.

Patient	SDG	Cardioversion	Complications	Maintenance Treatment
1	26	Electrical (two downloads, minimum 100 J, maximum 200 J)	-	Sotalol 80 mg/día
3	Puerperium righ now	Electrical (two shocks, 150 J)	-	Initially propafenone 300 mg, then disopyramide 250 mg/12 hours
4	Puerperium mediate (3 days)	Pharmacological (verapamil 5 mg plus propranolol 1 mg), + electric (three downloads minimum 50 J, maximum 175 J)	Oliguria, acute pulmonary edema, mechanical ventilation	Propranolol 40 mg/12 horas
5	34	Eléctrica 150 J	-	Diltiazem 30mg c/8hrs, Propanol 20 mg c/8 hrs
8	26,4	Electrical cardioversion on three occasions		Propafenona y metoprolol

J: Joules

who required cardioversion of 100, 200 and 300 J, and resolved at 36.6 weeks of gestation by caesarean section due to fetal bradycardia without complications. Klepper reported that a 28-year-old woman with 35 weeks of gestation required 100, 200, 300 J without response; she was subsequently administered Practolol as a slow infusion and a 400 J shock, and the pregnancy resolved at 40 weeks without complications [15,16].

On the other hand, it is important to note that women who were cardioverted with drugs received verapamil, considered by the PLLR (Pregnancy and Lactation Labeling Rule) in yellow (it can be used with caution) being effective in three cases of paroxysmal supraventricular tachycardia. Maintenance treatment consisted of the administration of beta blockers and calcium antagonists in pregnancy. Various reviews report as beneficial the use of verapamil for the treatment of maternal arrhythmias including supraventricular tachycardia, referred to in the Spanish Cardiology Journal.

This publication is the first experience in a reference center in Mexico, which deals with the benefits of an electrical cardioversion during pregnancy. The main limitation of the study is the number of cases being carried out in a single Institution; however, the publication aims to contribute to the dissemination of the therapeutic strategies available to reduce maternal morbidity and mortality.

Conclusions

- Our patients manifested hemodynamic compromise and neurological alteration that mostly required electrical cardioversion to correct the rhythm and hemodynamic alteration.
- Cardiac arrhythmia manifests regardless of maternal age or gestational age, although our patients were young and with pregnancies less than 25 weeks' gestation, being mostly primiparous.
- Cardiac structural alteration is an important causal factor for cardiac arrhythmia during pregnancy, although there were cases in which this pattern was not found.
- Electrical and pharmacological cardioversion are safe therapeutic strategies to treat cardiac arrhythmias during pregnancy.
- Despite treatment, recurrence of arrhythmias is possible, and maintenance therapy is recommended.
- The most frequent arrhythmia in our cases was supraventricular tachycardia.

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