Case Report

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Cardiac Conduction Defects and Pacemaker in Pregnancy – Case Series

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Abstract

Pregnancy is a state of hyperdynamic circulation. Any additional load on the already burdened heart in a pregnant woman is a threaten to the life of the mother and fetus. This case series on conduction cardiac abnormalities in pregnancy includes three patients with congenital complete heart block with pacemaker in situ, sick sinus syndrome with pacemaker in situ and a case of Wolff Parkinson White Syndrome in pregnancy respectively. In spite of arrhythmias being one among the commonly encountered cardiac complications in pregnancy, there is limited evidence on management of arrhythmias and patients with pacemakers in pregnancy. Management of these patients should include pre-conception counselling, antenatal, intrapartum and postpartum care with a multi specialist team comprising of obstetrician, cardiologist and anaesthetist. A basic knowledge on monitoring and functioning of pacemakers is of important in managing such cases.

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INTRODUCTION

Sexual differences in cardiac electrophysiology has been reported to be a contribution of sex hormones. Oestrogen is found to prolong the QT interval, while progesterone may have a reducing effect on the QT interval. SVT, atrioventricular nodal re-entry tachycardia (AVNRT) and sick sinus syndrome are more common in women [1]. Pregnancy constitutes an increase in progesterone, thereby contributing increased frequency, duration and more aggressive symptoms of supraventricular tachycardia (SVT). SVT is the most common arrhythmia reported in 22-33 per one lakh pregnancies. The risk of new onset SVT is highest in pregnant patients with WPW syndrome. 50 % of pregnant women experience non-sustained ventricular arrhythmias. But in the absence of structural heart disease, there is low clinical risk of sustained ventricular arrhythmias [2]. Treating obstetricians should have a broad knowledge on the optimal treatment of these patients with either anti arrhythmic drugs or Intra-cardiac Defibrillator. In this case series, we report three cases of high cardiac risk associated with a threat of arrhythmia and their successful management in our tertiary care centre.

Case Report 1

A 21 year old primigravida of 36 weeks gestational age, booked and immunised at SMCH, is a known case of congenital complete heart block since the age of 13 years. She was implanted with a permanent steroid eluting pacemaker in Right ventricular

apex with a pacing rhythm of 60 beats per minute, impedance of 764 ohms, threshold of 0.5 volts and resistance of 9.6 mu. She was on regular follow-up with her cardiologist. She was admitted for evaluation in view of pain abdomen at 36 weeks of pregnancy. She gave a history of intermittent lower abdominal pain, increasing in frequency and intensity for a period of 3 hours. She perceived fetal movements well. No complaints of bleeding or leaking per vaginum, fever, breathlessness, loss of consciousness, chest pain. On examination her pulse was 60 beats per minute, regular in rhythm and normal volume, blood pressure was 110/70 mmhg in the left arm in sitting position. No signs of cardiac failure present. Cardiovascular and respiratory system examination was unremarkable. On per abdominal examination, uterus was term size, fetus in cephalic presentation, and three uterine contractions lasting for 15 seconds each over a period of 10 minutes recorded. On vaginal examination the cervix was uneffaced, the cervical os admitted tip of finger, presenting part was at -3 station and pelvis was gynecoid. The fetal heart rate was localised and a cardio-tocogram done showed prolonged fetal bradycardia (Figure 1).

Immediately ECG and Echocardiogram were done. ECG showed a regular pacing rhythm with a heart rate at 60 beats per minute. No ectopic beats were identified. Echocardiogram showed an ejection fraction of 60% with normal left ventricular systolic and diastolic function. After obtaining cardiologist and anaesthesiologist consultation, decision for emergency Caesarean section was taken. Antibiotic prophylaxis with intravenous ampicillin and gentamycin was given. After obtaining consent, LSCS was done under spinal anaesthesia. Intraoperative period was uneventful. A girl baby weighing 2.5 kilograms delivered. Post operatively she was observed in the intensive care unit with Holter monitoring for 24 hours. Thromboprophylaxis with low molecular weight heparin (enoxaparin 0.4 ml subcutaneous) was given. Patient was stable throughout the hospital stay and discharged on Postoperative day 7 with advice on follow up with cardiologist and contraception.

Case Report 2

A 33 year old G6P2L2A2, at 37 weeks and 6 days gestational age, with all previous normal vaginal deliveries, a known case of sick sinus syndrome with pacemaker in situ for the past 12 years was admitted in early labour. She was diagnosed with sick sinus syndrome in the postpartum period after delivering her second child in 2010. She claimed to have lost all her medical records. She was not on regular cardiology follow-up. She gave history of abdominal pain for past 3 hours, increasing in intensity and frequency. She also complained of clear leaking per vaginum for past 1 hour. She perceived fetal movements well. She had no complaints of bleeding per vaginum, palpitations, breathlessness, chest pain, fever, cough, loss of consciousness. She has no other co-morbidities and no previous surgeries in the past. On examination, her pulse was 62 beats per minute, regular in rhythm, normal in volume, her blood pressure was 120/80 mmhg in the left arm. She had no signs of heart failure. On cardiovascular auscultation a pacemaker click heard over the precordium. Respiratory system examination was unremarkable. On abdomen examination, uterus was 36 weeks size, fetus in breech presentation, two uterine contractions lasting for 30 seconds and 35 seconds respectively over a period of 10 minutes was recorded. Fetal heart sound localised and measured to be 140 beats per minute. On speculum examination, clear amniotic fluid leak observed. On vaginal examination cervix was 40% effaced, cervical os was 3 centimetres dilated and membranes were absent and fetal foot felt. Ultrasound examination confirmed footling presentation (Figure 2).

ECG showed regular pacing rhythm with a heart rate of 62 beats per minute. Electrocardiogram showed an ejection fraction of 64% with normal left ventricular systolic and diastolic function. Cardiologist confirmed goof working condition of the pacemaker and stable cardiac status. Antibiotic prophylaxis with intravenous Ampicillin and Gentamycin was given. After cardiologist and anaesthesiologist consultation, emergency Caesarean section along with sterilization was done under epidural anaesthesia. Intra-operative period was uneventful. A boy baby weighing 2.7kgs was delivered by breech extraction. Postoperatively the patient was monitored in intensive care unit with Holter monitoring for 24 hours. Thromboprophylaxis was given with low molecular weight heparin (0.4 ml subcutaneous enoxaparin). Battery life of pacemaker is checked by specialist biomedical engineers. Patient was discharged on post-operative day 8 with strict advice on follow-up with cardiologist.

Case Report 3

A 25 year old primigravida of 31 weeks and 5 days gestational age booked at outside hospital was referred to our tertiary care centre in view of oligohydramnios with an AFI of 6.2cms. She was diagnosed to be a case of Wolff Parkinson White syndrome 6 months back on routine ECG done in the first trimester. She was admitted for evaluation and management of oligohydramnios. She gave no his-

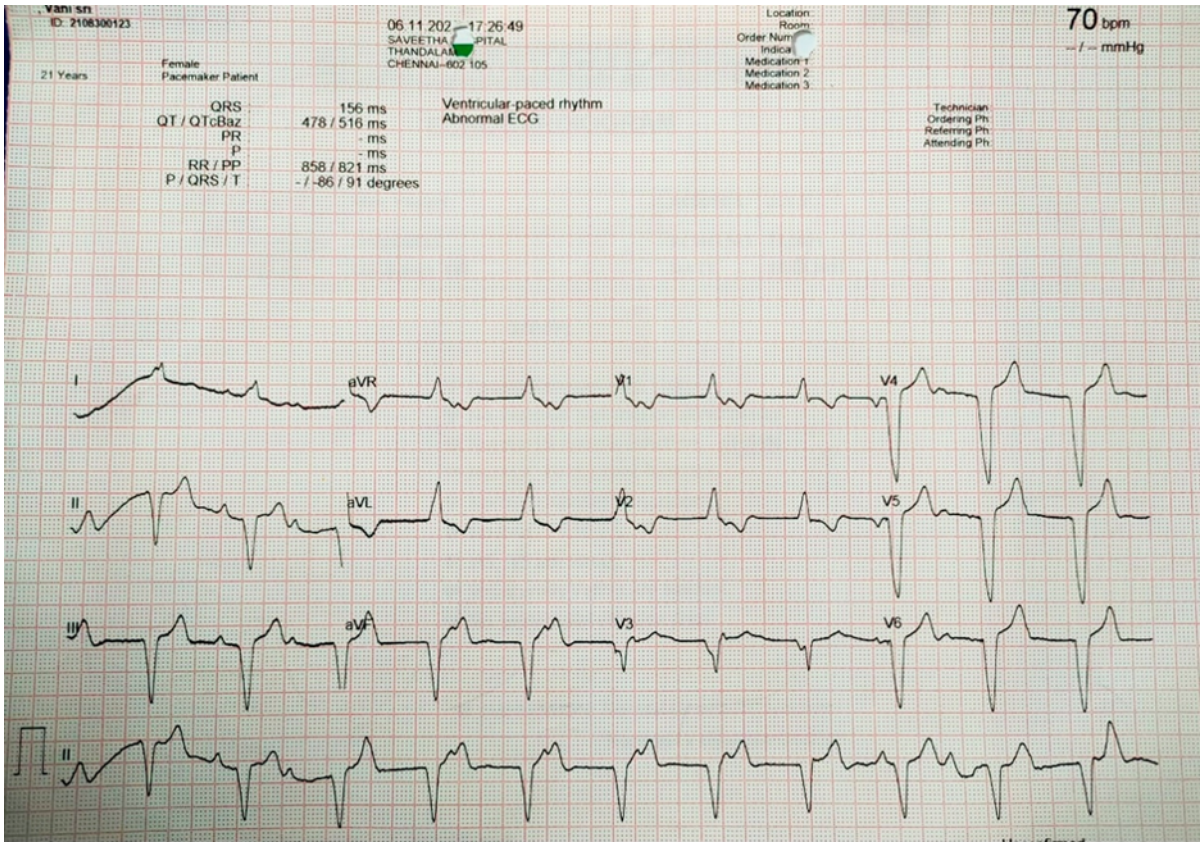

Figure 1: ECG Tracing of the Patient with Congenital Complete Heart Block with Pacemaker

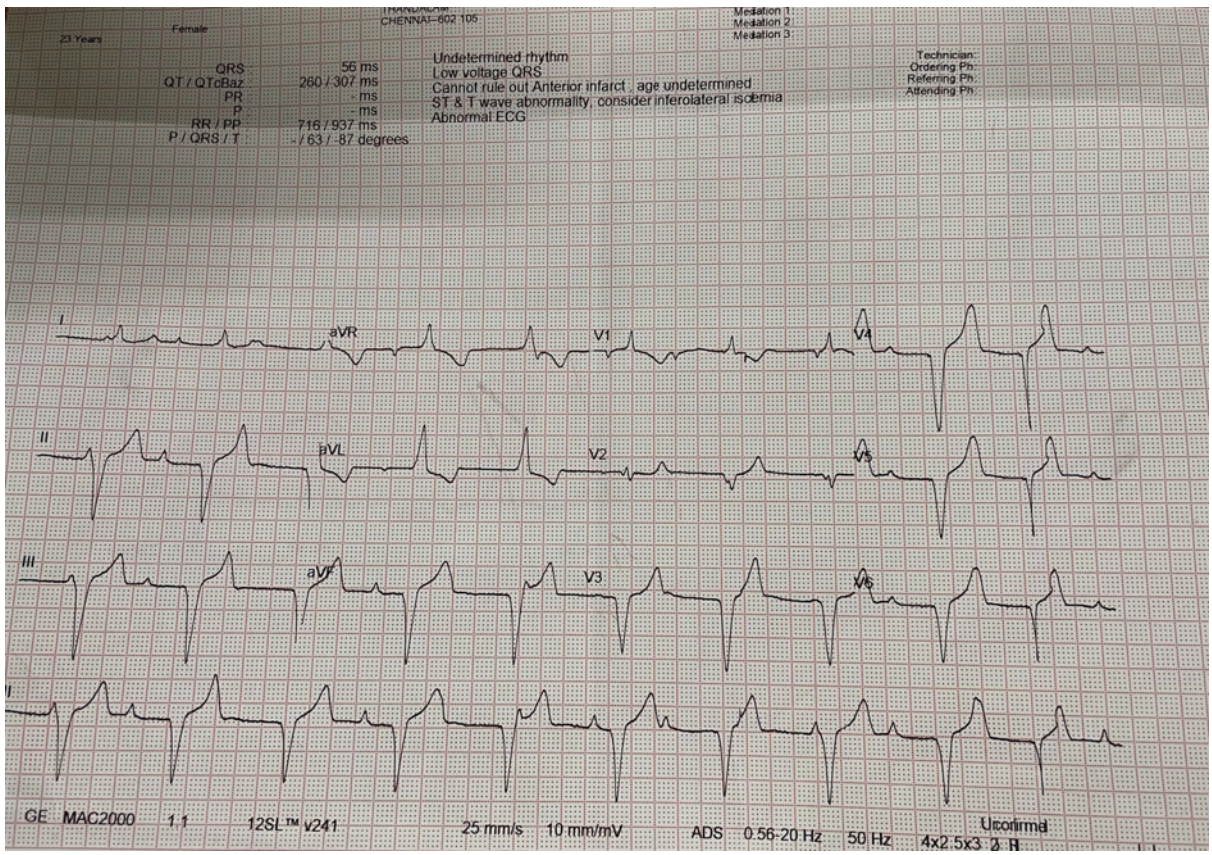

Figure 2: ECG Tracing of the Patient Sick Sinus Syndrome with a Pacemaker (Pacing Rhythm Noted)

tory of chest pain, palpitations, loss of consciousness, breathlessness, leaking per vaginum, bleeding per vaginum or abdominal pain. She had no other co-morbidities or previous surgeries. On examination, she was febrile. Her pulse was 92 beats per minute, regular in rhythm and normal volume. Blood pressure was 120/70 mmhg in left arm. On cardiovascular auscultation first and second heart sounds heard. No murmurs or added sounds. Respiratory system examination was unremarkable. On abdominal examination, uterus was corresponding to 30 weeks, relaxed, fetal heart rate localised over left spino umbilical line, 130 beats per minute. Vaginal speculum examination had no evidence of amniotic fluid leak and cervical os was closed (Figure 3).

ECG done showed short PR interval and Delta waves slurring across QRS complex with a heart rate of 92 beats per minute. Echocardiogram showed mild TR, mild PAH, Ejection fraction was 62%. Cardiologist opinion was obtained and stable cardiac status ensured. Routine investigations were done along with fever profile. Antenatal ultrasound showed severe oligohydramnios (AFI 3.2cms) with cerebroplacental ratio less than one. Decision for emergency LSCS was planned. Specialist team consultation including a cardiologist, anaesthesiologist and neonatologist was obtained. Intraoperative period was uneventful. A preterm baby weighing 1.4 kg was delivered. Peri operatively she was monitored for signs and symptoms of arrhythmias and heart failure in the intensive care unit. Patient condition was stable. Repeat ECG and ECHO were within normal limits. She was referred to cardiology clinic for follow up before discharge.

DISCUSSION

Cardiac complications in pregnancy accounts a significant cause of maternal mortality. There is a significant under diagnosis and under reporting of the incidence of arrhythmias in pregnancy. Pregnancy constitutes electro cardiac changes like QRS axis deviation, small Q and inverted P wave in lead 3, ST segment and T wave changes, frequent sinus tachycardia, development of new arrhythmias [3]. Furthermore, the physiological changes in cardiovascular system in pregnancy which includes increase in stroke volume and heart rate may increase the need for pacemaker in these patients. The three cases discussed above are potential candidates intensive Icaris monitoring and require high vigilance for cardiac arrhythmias.

Atrioventricular block is considered congenital when it occurs spontaneously in a young child. The incidence of congenital CHB varies between 1 in 15,000 to 22,000 live births [1]. Exposure of the fetus to maternal autoantibodies (anti Ro/SSA, Anti La/SSB) in cases like SLE or Sjogren's syndrome resulting in injury to fetal conduction tissues is the pathophysiology in 60-90% cases. The underlying pathology is replacement of AV nodal and conduction system by fibrous tissue by antigen-antibody reaction. Some forms of congenital heart defects like transposition of great arteries, endocardial cushion defects, atrial septal defects are associated with developmental abnormalities of atrio-ventricular conduction systems. Idiopathic CHB has been describes in patients with structurally normal heart. 40 % of CHB presents later in childhood. The primary presenting symptoms include reduced exercise tolerance, pre syncope or syncope with signs of bradycardia with atrial and ventricular activity is seen independent of each other and the atrial rate being faster than the ventricular rate in ECG. Pacemaker is the ideal treatment of choice with excellent prognosis in CHB. The type of pacemaker depends on the patient's age and size. However, these patients must be followed up for evaluation of dilated cardiomyopathy and heart failure in future.

Wolff-Parkinson white syndrome is a condition where patients have a pre-excitation syndrome with an additional pathway known as accessory pathway which directly connects the atria and ventricle. These accessory pathways are capable of antegrade and retrograde conduction between atria and ventricle. Diagnosis is mostly incidental by ECG. The pre-excitation signals as a result of fusion between normal AV node His-Purkinjee system and the accessory pathway manifests on ECG as shortened PR interval and widened QRS complex due to a delta wave. Ambulatory ECG monitoring for 24-48 hours with or without sodium channel blocker is recommended in patients for risk stratification. There may be associated cardiac abnormalities with WPW syndrome like Ebstein anomaly, mitral valve prolapse, hypertrophic cardiomyopathy. It is important to distinguish between WPW syndrome and WPW pattern in the ECG before diagnosis. The overall incidence rate of arrhythmia in WPW syndrome is 1%. The incidence of sudden cardiac death in asymptomatic patients is as low as 0.13 % [4]. An inherited form of WPW syndrome associated with familial WPW syndrome is reported to be due to PRKAG2 gene or LAMP-2 gene (Danon disease).

Sick sinus syndrome also known as sinus node dysfunction is characterised by SA node dysfunction. The typical symptoms include lightheadedness, fatigue, palpitations, presyncope or syncope [5]. It is important to exclude the reversible causes of SA nodal dysfunction like beta blockers,

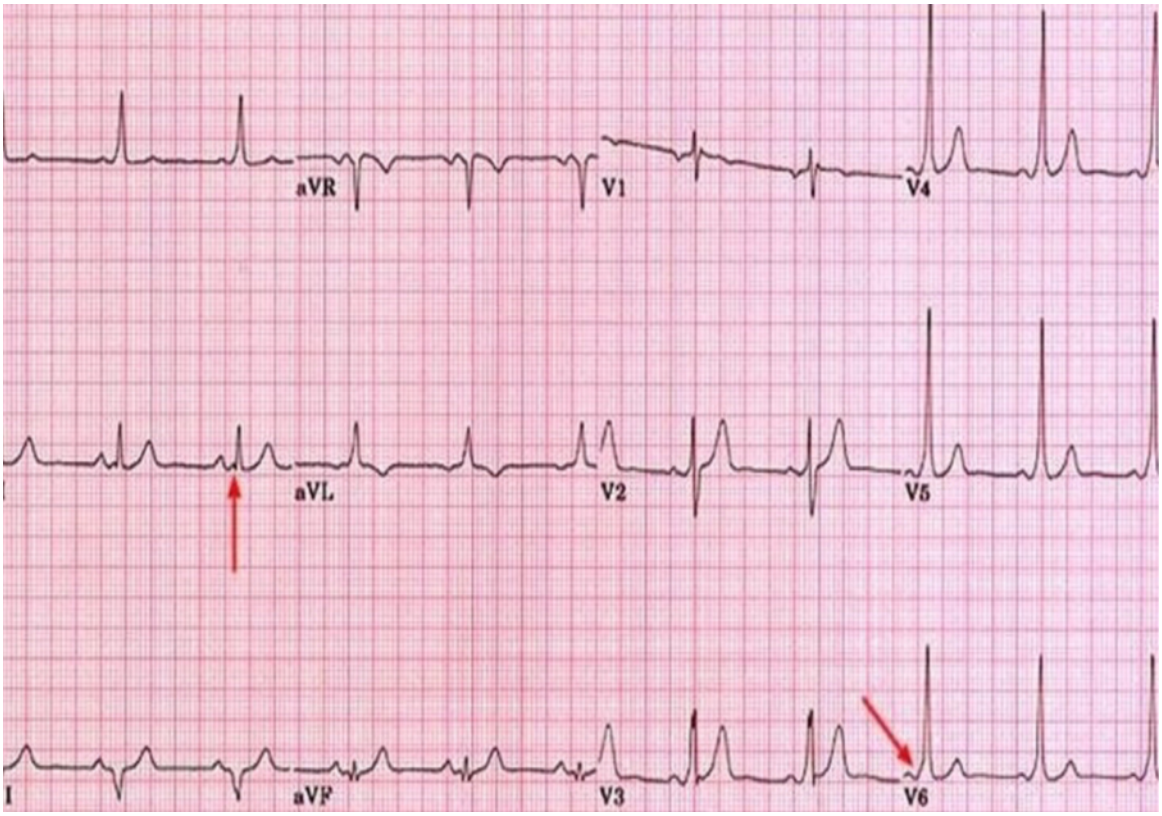

Figure 3: ECG Tracing of the Patient with Wolff Parkinson White Syndrome Showing Delta Wave

calcium channel blockers, digoxin, anti arrythmics use. ECG findings may include periods of inappropriate or severe bradycardia. Alternating bradycardia and tachyarrhythmia are seen in over 50 % of patients [6]. Over time atrial arrhythmias may develop. Ambulatory Holter monitoring for prolonged periods of upto 4 weeks is better in establishing diagnosis. Exercise stress testing is also used in diagnosis of SA nodal dysfunction and aid in programming pacemaker setting. Pharmacological challenge with atropine, isoproterenol or adenosine are alternatives to invasive electrophysiological studies, but rarely used in practise.

Anti-Arrhythmic Drugs in Pregnancy

Most anti arrhythmic drugs are category C drugs with potential teratogenicity by the FDA. Most beta blockers are classified as category C drugs. Sotalol, Pindolol and Acebutalol are classified as category B, however Atenolol is categorised at category D as it causes fetal growth retardation. Amiodarone is category D drug and warfarin is category X and should not be used at all in pregnancy due to the teratogenicity.

Pacemaker

The basic parts in a pacemaker are a pulse generator and electrode leads. Permanent pacemaker leads are placed through cephalic, subclavian or axillary veins. External programming of pacemaker with radio waves is done. The NASPE/BPEG generic pacemaker code consisting of five letters is used to identify the type of pacemaker. The first letter denotes the pacing chambers of the pacemaker, the second letter refers to the chambers in which sensing occurs. A, indicates atrium, V, indicates ventricle, D, indicates dual chamber. The third position refers to the response of the pacemaker to a sensed event, O indicating none, T indicating triggered, I indicating inhibited and D indicating dual chambers. The fourth letter indicates the presence or absence of rate modulation. The fifth letter indicates the potential and location of multisite pacing. Pacemakers are selected based on the abnormality. There are both rate sensitive and rate fixed pacemakers. The rate sensitive pacemakers are preferred in pregnancy because of its ability to increase the heart rate in response to exercise. The American College of Cardiology / American Heart Association has drawn guidelines for implantation of a pacemaker as follows [1].

Group 1- Definite Indications of Pacing

1. Acquired complete AV block.
2. Congenital complete heart block with severe bradycardia (< 70 bpm when associated with congenital heart diseases).

3. Symptomatic Mobitz type II and type I AV block.
4. Symptomatic sinus bradycardia.

Group 2- Possible Indications for Pacing

1. Asymptomatic type 1 2^{nd} degree AV block at intra or infra His level when found incidentally on EKG.
2. First degree AV block when there is hemodynamic compromise.
3. Congenital complete heart block beyond first year of life with average heart rate of <50 bpm or abrupt pauses in ventricular rate which are double or triple the basic cycle length.
4. Bifascicular or tri fascicular block accompanied by syncope.
5. Asymptomatic Mobitz II- second degree AV block.
6. Symptomatic sinus bradycardia where there is not a clear association between bradycardia and significant symptoms.

Pre-Conceptional Care

Ideally the vigilance should start pre-conceptionally in women at risk of arrhythmias who desire pregnancy. It is continued with high alert antenatal surveillance, intrapartum management and postnatal follow-up. Maternal risk factors include previous history of arrhythmia, advanced maternal age, African race, and congenital heart diseases with surgical scar or anatomical abnormality. The recurrence rate of AF during pregnancy in a patient with a past history of AF is 25- 50%. The at-risk population should receive a pre-conception counselling by a specialist maternal fetal medical expert regarding the symptoms suggestive of arrhythmia and the immediate measures that are necessary. One should also be informed about the potential risks involved in their pregnancy and the treatment options available. This also provides a platform for detailed assessment of cardiac status and planning treatment for optimisation of cardiac function and preemptively changes her prescription appropriate for pregnancy before conception. Although no antiarrhythmic drug is completely safe in pregnancy, most of these drugs are well tolerated. Propranolol, metoprolol, digoxin were extensively tested and proved to be safe in pregnancy. It is best to avoid drug therapy in the first trimester of pregnancy as clinical data on the safety profile of these drugs are limited. In patients already on pacemaker, an EKG, ECG and baseline pacemaker interrogation on the type, working condition and battery life of the device should be checked and expert opinion obtained. Some cardiac lesions may be a part of a larger syndrome diagnosis in parents, hence genetic counselling regarding fetal cardiac anomalies should be considered in appropriate cases.

Antepartum Care

Effective circulating blood volume increases by 30-50% at the beginning of 8 weeks of pregnancy and peaks at 34 weeks. The cardiac output also increases with an average of 6.7 L/min in the first trimester and < or = 8.7L/min in the third trimester. This is due to an increase of 35% in stroke volume and 15% increase in heart rate. Increase in plasma volume causes stretching of atrial and ventricular myocytes, resulting in early depolarisation, shortened refractoriness, slowed conduction and spatial dispersion through activation of stretch-activated ion channels. These along with hormonal and autonomic changes will predispose the pregnant mother to arrhythmias. A high resting heart rate has been used as a marker for arrhythmogenesis. Careful monitoring with obstetrician and cardiologist with regular ECG should be done. Safety profile of anti arrhythmic drugs as already discussed should be kept in mind. In cases where there is hemodynamic instability associated with arrhythmias, as in sustained SVT, electric cardioversion is a reasonable option and the risk of fetal arrhythmia has been reported to be small. However, few reports of inducing preterm labour have been reported in the later stages of pregnancy. Fetal monitoring for arrhythmias is recommended in cases of emergency cardioversion before caesarean delivery.

The ESC, European Society of Cardiology, has formulated guidelines for management of SVT during pregnancy.

Low Risk Conditions

PSVT, AF, WPW.

Treatment Suggested

Consult cardiologist, plan the obstetric management (mode and place of delivery) based on indication.

Medium Risk

Unstable SVT.

Treatment Suggested

1. Consultation with multi-disciplinary team,
2. Plan obstetric management,
3. Monitor cardiac rhythm,

4. Intravenous line, prepare for IV administration of adenosine, beta-blocker,
5. External Cardioverter Defibrillator at site.

Usually patients with pacemaker tolerate pregnancy well. Throughout pregnancy, attention to new onset of symptoms like palpitations, shortness of breath, syncope, seizure-like activity, exercise intolerance is necessary. This will follow with further evaluation and adjustments of pacing rate. Thaman et al reported their experience with 11 pregnant patients with pacemakers and reported that 3 patient developed maternal complications namely cardiac decompensation in one patient recurrent palpitations due to short run of atrial fibrillations in one and progressive right ventricular failure in one patient [1]. Thus careful cardiac surveillance especially in cases with structural heart defects is recommended. Pacemaker dependency should be assessed as these patients require extra precautions during surgery. Reports of recurrent pulmonary emboli secondary to large thrombi along the pacemaker lead, with good response to anticoagulation with heparin in symptomatic cases are available. Mostly preferred anticoagulants are heparin derivatives as warfarin has been reported with teratogenic effects on the fetus especially in the first trimester. In patients with mechanical valves, there are reports of higher incidence of valve thrombosis with heparin compared to warfarin. However adequate data regarding absolute clinical guidelines is lacking.

Intrapartum Care

A detailed consensual approach to delivery and intrapartum care should be planned by the obstetrician, cardiologist and anaesthesiologist during antenatal period. There is no contraindication for vaginal delivery in these patients. During the first stage of labour, cardiac output increases by 12% and 34% during the second stage. Epidural anaesthesia will help in attenuation of these changes and epidural anaesthesia is preferred over spinal anaesthesia, in view of maternal hypotension. ECG is done to diagnose pacemaker dysfunction if any. It is important to correct electrolyte imbalances especially hypokalemia and hyperkalemia, as they might affect the pacing threshold. Adequate hydration and vasopressors should be used so that the hemodynamic changes are minimised. There have also been reports of patients undergoing temporary pacing during labour to prevent the occurrence of significant bradycardia associated with Valsalva manoeuvres [7]. It is recommended to perform delivery in lateral decubitus position which reduces hemodynamic fluctuations during bearing down. Continuous ECG tracing to look for arrhythmias and In the case of Caesarean sections, the anaesthesiologist should note the pacing mode, date of implantation, durability of batteries of the pacemaker [8]. Short bursts of bipolar electrocautery can be used in patients with pacemaker as unipolar cautery is known to cause electromagnetic interferences with the pacemaker leading to asystole in pacemaker dependent patients [4]. The grounding plate for the cautery system is kept as far as possible from the pacemaker. In case of electromagnetic interference of the pacemaker, an asynchronous pacing mode (VOO) by promming or by placing a magnet over the device is recommended [7, 9].

Postpartum Care

Patients with high risk factors for developing cardiac conduction defects should be identified and counselled regarding anti-arrhythmic medications, pacemaker implantation or renewal or surgeries after specialist consultation. They should be advised to visit the hospital in case of symptoms suggestive of arrhythmia like syncope, lightheadedness, sweating, anxiety etc. Routine consultation with cardiologist, ECG, trans-thoracic ECHO is of utmost importance. High risk patients can be given the option of insertable cardiac monitor that can last as long as 3 years. Postpartum return of cardiac function to baseline should be associated with change of anti-arrhythmic drugs and adjustment of pacemaker to appropriate setting. Birth spacing and contraceptive counselling is necessary. IUCD and progesterone only pills can be safely used in all cardiac conditions.

CONCLUSION

Cardiac conduction defects in pregnancy require a multidisciplinary approach. Symptoms of cardiac dysfunction often mimic common pregnancy symptoms. It is essential to have increased vigilance in identifying complications. The physiological changes in pregnancy and postpartum require pharmacological dose adjustments or pacing rate adjustments in cases with pacemaker. Importance of thrombo-prophylaxis in such cases should be emphasised. Route of delivery is purely based on obstetric indications in stable cases. Care should be taken regarding the use of electrocautery in patients with a pacemaker. Pre-pregnancy counselling and post natal follow up of high risk cases is mandatory.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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