

Cardiac outcome of pregnancy in women with a pacemaker and women with untreated atrioventricular conduction block

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Aims

The natural history and outcome of pregnancy in patients with a pacemaker or those presenting with atrioventricular conduction block in pregnancy are unknown with only a limited number of case reports published.

Methods and results

This study examines the progress and outcome of 25 pregnancies in 18 women who were either paced or presented with untreated atrioventricular conduction block during pregnancy. All patients were seen in a single referral centre between 1998 and 2008 and were evaluated at regular intervals with ECG, echocardiography, and 24 h Holter. Four women (4 pregnancies) had new-onset atrioventricular block, 3 women (5 pregnancies) had previously diagnosed atrioventricular block who had not undergone pacing, and 11 women (16 pregnancies) had known atrioventricular block with a pacemaker prior to pregnancy. Of the four patients presenting for the first time in pregnancy, the frequency or severity of atrioventricular conduction block increased during pregnancy. One required pacing during and one after pregnancy. In two patients the conduction disturbance resolved postpartum. In the three patients who had known but untreated atrioventricular block before pregnancy, this progressed during each pregnancy but did not require pacing. In patients paced before pregnancy, there were no complications as a result of the pacemaker, but maternal complications were seen in patients with underlying structural heart disease.

Conclusions

Atrioventricular block in pregnancy is progressive; pacing is not always required but all patients should be closely monitored during and after pregnancy. In patients paced before pregnancy, pacing is well tolerated.

Keywords

Atrioventricular conduction block • Pacing • Pregnancy

Introduction

Although uncommon, an increasing number of women with implanted pacemakers are contemplating and undergoing pregnancy. In addition, some women may enter or present during pregnancy with untreated atrioventricular conduction block. Although different, these situations continue to present a difficult management dilemma. Cardiac and obstetric experience in such women is limited with only a few case reports found in the literature.^{1–3} We report on 25 (singleton) pregnancies in 18 women who were evaluated in a specialist cardiac obstetric unit, their clinical course, management, and outcome.

Methodology

The Bristol Royal Infirmary is a tertiary referral centre for cardiology and congenital heart disease and incorporates a dedicated cardiac obstetric service that accepts referrals from the south-west of England. During 1998–2008, 11 women (16 pregnancies), median age 28 years, with a previously implanted pacemaker and 7 patients with untreated (without a pacemaker) atrioventricular conduction disease were evaluated during pregnancy. Of the seven patients who did not have a pacemaker at presentation, four (four pregnancies), median age 26 years, presented for the first time in pregnancy and three (five pregnancies), median age

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Table 1 Patients with a pacemaker prior to pregnancy

Mode of pacemaker	Indication for pacing	Underlying cardiac disease	Problems during pregnancy	Pregnancy outcome
VDD	Congenital CHB	LV impairment, hypertension	Breathlessness and heart failure	NVD
DDDR	Radio frequency ablation with post-procedure CHB	Fascicular tachycardia	None	NVD × 2
DDI	Cardioinhibitory syncope	None	None	NVD
AAIR	Sick sinus syndrome with syncope	None	None	NVD × 2
Dual-chamber ICD	Syncope	Arrhythmogenic right ventricular cardiomyopathy	None	NVD
DDDR	Congenital CHB	None	None	NVD × 2
DDDR	Radio frequency ablation with post-procedure CHB	Wolff–Parkinson–White	None	NVD
DDDR	First-degree and intermittent AV nodal block	Atrial septal defect repair 1982	Brief runs of atrial fibrillation in third trimester	NVD
Epicardial DDDR	Surgical CHB	Ebstein's anomaly and atrial septal defect. Tricuspid valve repair and closure of ASD followed by tricuspid valve replacement Atrial tachycardia, hyperthyroidism	Breathlessness and reduction in right ventricular function in second pregnancy	NVD × 1IUD at 20 weeks
Bi-ventricular pacemaker	CHB	LV impairment, mitral valve repair, and tricuspid valve annuloplasty	None	NVD
DDDR	CHB	LV enlargement, long QT syndrome	None	NVD

VDD, atrial synchronous ventricular inhibited pacemaker; LV, left ventricular; CHB, complete heart block; DDDR, dual-chamber rate-responsive pacemaker; AAIR, atrial demand inhibited pacemaker; DDI, dual-chamber inhibited pacemaker; ICD, internal cardioverter defibrillator; NVD, normal vaginal delivery; IUD, intrauterine death.

25 years, had previously diagnosed but untreated atrioventricular block.

All patients underwent clinical evaluation, including history and review of historical data from case records, examination, 12-lead ECG, sequential transthoracic echocardiography, and 24 h Holter monitoring. All patients were followed at regular intervals during and after their pregnancy and were closely monitored during labour with continuous ECG recording and facilities for transcutaneous as well as transvenous pacing. In patients who were already paced, the lower and upper tracking rates were increased by 10 bpm in order to allow for the physiological adjustment of heart rate seen in pregnancy.

Results

Patients with a pacemaker prior to pregnancy

The clinical details of these 11 patients (14 pregnancies) together with the indications for pacing are shown in Table 1. Five patients had underlying structural heart disease, including arrhythmogenic right ventricular cardiomyopathy, left ventricular (LV) enlargement, repaired atrial septal defect, and Ebstein's anomaly. Eight patients were paced for atrioventricular conduction disease (all for complete heart block), including one individual who had a biventricular pacemaker for intermittent complete heart block and LV systolic dysfunction. The others had pacemakers for a variety of reasons

including sick sinus syndrome with significant bradyarrhythmia and cardioinhibitory syncope, and one patient had an implantable cardioverter defibrillator for arrhythmogenic right ventricular cardiomyopathy and syncope (primary prevention).

The majority (eight patients) had prepectoral pacemakers, one patient had a subpectoral implant, and two individuals had an abdominally implanted pacemaker. Eight patients were paced using the transvenous route and the others had epicardial pacing systems including the patient with the biventricular pacemaker who had an epicardially placed LV lead. There were no complications relating to either the pacing systems or the leads during pregnancy. In particular, there were no lead fractures or displacements.

Maternal complications were seen in three patients, all of whom had underlying structural heart disease. One patient with a pacing system (VDD) for congenital complete atrioventricular block and mild LV impairment developed cardiac decompensation in the third trimester and was induced at 38-week gestation. She had an uneventful labour and delivered by vaginal delivery. The postpartum period was uncomplicated with some recovery of LV function. Another patient who was paced [dual-chamber rate-responsive pacemaker (DDDR)] after developing intermittent second-degree heart block following surgical repair of an atrial septal defect developed recurrent palpitation secondary to short runs of atrial fibrillation; otherwise her pregnancy, labour, and postpartum period were uncomplicated. The third patient developed progressive right ventricular dysfunction and suffered a

foetal intrauterine loss at 20 weeks into her second pregnancy. This patient had Ebstein's anomaly of the tricuspid valve. She had undergone tricuspid valve repair followed by valve replacement prior to pregnancy and had significant right ventricular impairment. She was also taking 10 mg/day of warfarin at the time of foetal loss and post-mortem examination was suggestive of warfarin embryopathy.

Patients with untreated atrioventricular conduction disease

Women presenting for the first time in pregnancy with untreated atrioventricular conduction disease

Of these four patients, only one had evidence of any underlying structural cardiac abnormality. This patient had a history of myocarditis with mild LV enlargement and systolic impairment. This patient developed dizziness at 32 weeks{32-week} gestation and ECG showed first-degree atrioventricular block and intermittent Mobitz type II second-degree atrioventricular block. From 36 weeks onwards, she developed intermittent complete heart block. The rest of her pregnancy course was uneventful and she had a spontaneous vaginal delivery at term without the need for pacing. Postpartum her ECG returned to normal. Two other patients also presented during the antenatal period between 14- and 32-week gestation. One presented with dizziness and had first-degree atrioventricular block with intermittent Wenkebach and Mobitz type II block; this progressed to intermittent complete atrioventricular block towards the end of pregnancy. This patient delivered normally without maternal or foetal complication and was not paced. Postpartum her ECG returned to normal with normal PR duration. The second patient presented after three syncopal events with complete atrioventricular block and was paced for prolonged (>3 s) pauses. Pacing was not associated with any complication and there were no further problems encountered either during the antenatal period or during labour in those patients who were paced. The final patient presented in labour after having had an uncomplicated antenatal period. During labour and while in the delivery suite she was noted to be bradycardic with a heart rate of ~50 bpm; ECG confirmed complete atrioventricular block. This patient was given syntocinon to augment labour for slow progression and underwent forceps to hasten delivery. Foetal bradycardia was recorded towards the end of labour but was transient; maternal pacing was not required. Postpartum her ECG continued to show complete atrioventricular block and she subsequently underwent insertion of a permanent dual-chamber pacemaker.

Women with known but untreated atrioventricular conduction disorder prior to pregnancy

Three patients (five pregnancies) who were known to have atrioventricular block were not paced before pregnancy. One had presented 2 years prior to her first pregnancy with an episode of dizziness, and investigations had revealed first-degree and intermittent Mobitz type II block. This patient had two uneventful pregnancies with no foetal or maternal complications, although she had complained of frequent dizziness in the first trimester in each of her pregnancies and 24 h Holter confirmed

persistent first-degree and Mobitz type II atrioventricular block during pregnancy. The second patient was born with transposition of the great arteries and had undergone an atrial switch (Senning) type of repair in early childhood. She was known to have first-degree atrioventricular block (PR duration 210 ms) with an intermittent nodal rhythm and prior to pregnancy and was also taking digoxin for atrial arrhythmia. She continued to have intermittent nodal rhythm throughout her two pregnancies, but this was more frequent and prolonged compared with pre-pregnancy; there was also a small increase in her PR duration to 230 ms. Both pregnancies were otherwise uneventful. The third individual had LV enlargement of unknown aetiology and first-degree atrioventricular block with bi-fascicular block on a 12-lead ECG. She developed increasing PR prolongation during pregnancy with a maximal recorded PR duration of 370 ms. On ambulatory ECG, the lowest recorded heart rate was 42 bpm in the third trimester. Her pregnancy was otherwise uneventful.

Discussion

Our own experience, as well as systematic review of the literature, would suggest that pregnancy in patients with a pacemaker or those undergoing pregnancy with significant bradyarrhythmia/conduction disturbance is uncommon and has an unknown course with only limited numbers of case reports published.¹⁻⁴ In this series, we report the natural history of 26 such pregnancies. Furthermore, to our knowledge, this is the first report showing that atrioventricular conduction block during pregnancy may resolve postpartum, implying that pregnancy itself may affect the cardiac conduction system.

This study examines two important but separate groups of patients: the first group of patients were those with a pacemaker already *in situ* at the time of pregnancy; these patients were paced for a variety of reasons relating to bradyarrhythmia or atrioventricular conduction disease. The second group of patients were those with untreated bradyarrhythmia or atrioventricular conduction disease at the time of pregnancy. This group was further subdivided into those presenting for the first time and those with known conduction disorders but not paced. Patients with untreated conduction disease in pregnancy pose a particular problem as conventional guidelines for pacing are adopted by most physicians; however, specific guidance and data regarding pregnancy are limited.

In all the four patients who presented for the first time in pregnancy with previously undiagnosed conduction disease, the severity of atrioventricular conduction block and/or bradyarrhythmia increased during the course of pregnancy. Two patients required a permanent pacemaker during and one after pregnancy. These pacemakers were inserted for conventional, i.e. non-pregnant, indications; however, two individuals who had atrioventricular conduction block did not undergo pacing and the conduction block resolved postpartum. In these patients, we opted not to implant a pacemaker but rather to follow them closely with prolonged periods of cardiac monitoring, mainly because of a relative lack of symptoms and prolonged pauses as well as the intermittent nature of the complete heart

block. Moreover, they did not have evidence of any underlying structural heart disease.

In those patients who had known but untreated atrioventricular conduction disease prior to pregnancy, the frequency and/or severity of the bradyarrhythmia or conduction disease also appeared to increase but in all cases regressed to pre-pregnancy levels in the postpartum. All three had successful pregnancies without the need for any cardiac intervention.

The factors that could result in or exacerbate conduction delay in pregnancy are unknown but may relate to the normal physiological or haemodynamic changes associated with pregnancy. These changes have been well recorded and include an increase in pre-load due to increased circulating blood volume and a reduction in afterload due to a fall in systemic vascular resistance as a result of changes in resistance and flow in peripheral vascular beds.^{5,6} These changes lead to an increase in atrial and ventricular distension, and all four chambers increase in size from the first to the end of the third trimester.⁷ Although unproven, we could hypothesize that the increase in atrial stretch might be sufficient to provoke conduction disturbance in some previously unaffected women or unmask conduction disturbance in patients with a pre-existing substrate or subclinical disease. As well as the increase in atrial size, structural changes associated with atrial remodelling might also contribute towards an increased conduction delay or equally atrial arrhythmia during pregnancy. These changes might also explain the resolution of atrioventricular conduction delay observed in the postpartum period when these physiological changes would be expected to regress. The evidence for atrial stretch in pregnancy comes from both human and animal studies, which have shown progressive increase in left and right atrial dimensions as pregnancy advances in order to accommodate the increased volume load of pregnancy.⁷⁻¹¹ Further evidence can be derived from studies showing elevated atrial natriuretic peptide levels in pregnancy (particularly in mid-pregnancy) compared with the non-pregnancy state.¹¹⁻¹⁵ These peptides are known to be secreted as a result of increased intra-atrial pressure or distension.¹⁶

The largest group of patients evaluated in this series were those who had pacemakers already *in situ* at the time of pregnancy. This represents the largest subset of patients encountered by most physicians. In these patients, we observed no significant complications attributable to either the pacing system or leads. This is consistent with most recent studies and differs from some less contemporaneous reports taken either from an era when pacing was in its relative infancy or which included a high number of epicardial systems.^{1-3,5,17,18}

Underlying structural heart disease

In this study, there were a number of maternal complications reported (heart failure and atrial fibrillation) as well as one intra-uterine death. These complications were more likely attributable to exacerbation/deterioration of the underlying structural heart disease or the use of high doses of warfarin during pregnancy rather than pacing. This is supported by the fact that there were no complications observed in paced patients with no underlying structural heart disease.

Pacing during pregnancy

In the two patients who required pacing during pregnancy, this was performed under local anaesthesia using fluoroscopic guidance with shielding of the maternal abdomen. There were no complications as a result of the procedure and both women delivered healthy babies at term. There have been a number of reports of women undergoing permanent pacing during pregnancy without significant adverse effects; in some cases, transoesophageal echocardiography was used to guide the lead position.¹⁷⁻²¹ There have also been reports of patients undergoing temporary pacing during labour, which has been recommended by some in order to prevent the occurrence of significant bradycardia associated with Valsalva manoeuvres.²¹⁻²³ In this study, however, no patient experienced significant bradyarrhythmia during labour or at the time of delivery. This might be explained by the increase in sympathetic response that occurs during this stage or by the high uptake of regional anaesthesia that has also been advocated.²³⁻²⁵

Labour

Delivery was by Caesarean section under regional anaesthesia in four pregnancies; no patient required general anaesthesia. All Caesarean sections were performed for obstetric reasons only. Three deliveries were augmented by instrumentation for risk of potential cardiac decompensation. No delivery was augmented because of a change in atrioventricular conduction disease, bradycardia, or pauses.

Clinical significance

This study shows that not all patients who present with atrioventricular block during pregnancy require pacing. Moreover, it might be expected that conduction disorders would adversely affect a woman's ability to cope with the physiological stresses of pregnancy or labour. This was not the case; in fact, the outcome and course of pregnancy were more likely to be determined by the underlying cardiac disorder.

Limitations

There are two main limitations to this study: first, the small numbers and second its retrospective nature. However, these are inevitable, bearing in mind the infrequency of this condition in this population. Despite these limitations, this study provides important new data on the natural history and course of bradyarrhythmia/conduction disease in pregnancy.

Conclusions

Pacemakers are well tolerated in pregnancy. Untreated atrioventricular block/bradyarrhythmia in pregnancy tends to be progressive, although pacing is not always required. All patients should, however, be closely monitored during and after pregnancy.

Conflict of interest: none declared.

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