NORTH WEST
MATERNAL
MEDICINE NETWORK

Lancashire & South Cumbria
Cheshire & Merseyside
Greater Manchester & Eastern Cheshire

# North West Maternal Medicine Network

# Cardiac Disease in Pregnancy Guideline

## Document Control

This guideline is an adaption of V2 April 2022 Greater Manchester and Eastern Cheshire Strategic Clinical Network Cardiac Disease in Pregnancy Guideline. The Maternal Medicine Network would like to take the opportunity to thank all previous and current contributors for their engagement and dedication in supporting the development of this guideline.

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**Version control**

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| V0.1 | Circulated to the following groups for comments and feedback:<br>• Regional Guidelines Group<br>• North West Congenital Heart Disease Network<br>• GMEC SCN<br>• North West Coast SCN<br>• North West MMN Coproduction group | |
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Once fully ratified and endorsed, this guideline will be available for adoption across the entirety of the North West in order to ensure that women universally receive high quality care.

The MMN are committed to making maternal medicine care inclusive. We use the term 'women' throughout MMN documentation to refer to those who are planning to become pregnant, are pregnant and have given birth. We acknowledge that not all people who are pregnant and give birth identify as women. It is important that evidence-based care for maternity, perinatal and postnatal health is inclusive and tailored to an individual's wishes.

# Contents

## Cardiac Disease in Pregnancy North West Maternal Medicine Network

The North West Maternal Medicine Network (NW MMN) is responsible for ensuring that all women in the network's footprint with significant medical problems will receive timely specialist care and advice before, during, and after pregnancy. All constituent providers within the network will be responsible for agreeing and upholding shared protocols on the management and referral of women with medical conditions, including reviewing guidelines and referral pathways. This model of care will ensure that – where agreed appropriate – investigation and management is carried out by an experienced Multidisciplinary Team (MDT).

Most women with complications during pregnancy will continue to be managed by local maternity services. The proportion of a woman's care provided by a Maternal Medicine Centre (MMC) will vary according to individual need. For some women, a single visit to the MMC or communication with the MMC by the local unit will suffice. For the highest risk and most complex women, it may be that all care will be recommended to be provided within the MMC.

When referring women, be respectful and aware of all religions, languages, cultures and diversities such as transgender and non-binary to ensure best care for all. Please take into consideration the additional challenges faced by those who are from an ethnic minority, have a severe mental illness or are socially deprived as they are at a higher risk of poor physical health and poor outcomes, compared with the general population. The perinatal period adds further complexity, therefore please ensure you consider mental health needs and refer to your local perinatal mental health service appropriately

## Introduction and Scope

Cardiac disease is one of the leading causes of maternal death (MBRRACE, 2023).

A woman may know they have cardiac disease before they become pregnant, or it may be diagnosed during pregnancy or in the postpartum period. This guideline relates to women with pre-existing, suspected or newly diagnosed cardiac disease and includes congenital, acquired and inherited cardiac disease.

The Cardiac Disease in Pregnancy NW MMN Pathway supports this guidance.

## Obstetric Cardiac Services within NW MMN

The NW MMN underpins the guidance for lead providers of maternity care for women with cardiac disease in pregnancy across the region. It also supports a maternity tertiary care service for women with acquired and inherited cardiac disease across the three North West Local Maternity and Neonatal Systems (LMNS).

There is a designated MMC based in each LMNS that serve the Northwest region.

| LMNS | MMC |
|---|---|
| Greater Manchester and Eastern Cheshire (GMEC) | St Mary's Hospital Manchester |
| Cheshire & Merseyside (C&M) | Liverpool Women's Hospital (LWH) |
| Lancashire & South Cumbria (L&SC) | Royal Preston Hospital (RPH) |

The three MMC's encompass all maternity providers within the three LMNS's (Appendix 1). The centres function collaboratively as a network enabling coordination to deliver maternal medicine care to women throughout the NW region. This integrated approach ensures equitable expert care.

**For women requiring specialist cardiology input in GMEC and C&M, these patients should be referred to the local MMC's of St Mary's and LWH, respectively. In L&SC Obstetric Cardiology referrals for MDT review/advice should be sent to the Preston MMC electronically for notification purposes. The service will then be led by Blackpool Teaching Hospital as it is the lead service for Cardiology in L&SC.**

The Obstetric cardiology contacts in each LMNS are outlined in Table 1 below.

**Table 1: Cardiac Obstetric Clinics**

| MMC/Centre | Obstetrician | Cardiologist | Frequency |
|---|---|---|---|
| St Mary's Hospital Cardio-Obstetric Clinic | Dr A Roberts<br>Dr S Bonner | Prof Clarke<br>Prof Keavney<br>Dr D Cullington | Weekly Tues am |
| **Switchboard** | **SMH: 0161 2761234** | **MRI: 0161 2741234** | |
| Liverpool Women's Hospital Cardio-obstetric Clinic | Dr Z Castling<br>Dr N McGuinness | Dr V Sharma<br>Dr D Cullington<br>Dr R Ashrafi | Fortnightly Mon pm |
| **Switchboard** | **LWH: 0151 708 9988** | **RLUH: 0151 706 2000**<br>**LHCH: 01516001616** | |
| Royal Preston Hospital | Dr C Cox<br>Dr L Murphy | Dr W Khan | Monthly |
| **Switchboard** | **01772716565** | **01772716565** | |
| Blackpool Teaching Hospital | Dr L Haslett | Dr C Cassidy | Monthly |
| **Switchboard** | **Secretary: 01253 953645**<br>**Switchboard: 01253 300000 (bleep 1223)** | **Secretary: 01253 953368**<br>**Switchboard: 01253 300000 (bleep 1074)** | |

See appendix for referral details to each MMC.

Each MMC is equipped to facilitate and organise telemedicine across the MMN if it is safe for the woman. The option to facilitate consultations via telemedicine is available where it is difficult for the woman to attend a face-to-face appointment. Telemedicine will also be used where expertise is required for specific cases and clinicians from several providers need to work together as an MDT to implement joint care plans. This mitigates the geographical challenges that occur when experts are not based at the same Trust.

## Obstetric cardiac risk stratification

All women with cardiac disease should be risk stratified using the Modified World Health Organisation Classification of maternal cardiovascular risk (mWHO) as per Appendix 2. The adapted version in this appendix (includes conditions not mentioned in the mWHO guidance) provides a framework for appropriate location of care and delivery. It should be noted that for this guideline alone, the nationally agreed classification of maternal medical conditions, A, B, C, has been deferred, as the mWHO classification has been well established within cardiology, and has been used for consistency with that speciality.

Please consider additional co-morbidities alongside cardiac disease as the presence of other health conditions may require specialist support even if ordinarily the cardiac condition is deemed manageable at a local unit.

When considering referral to the MMC in your local LMNS please pay attention to the 'Care in Pregnancy' and 'Location of Delivery' sections as this provides guidance as to when referral to the LMNS MMC is recommended.

It is important that each woman is assessed, and care individualised.

Women stratified as mWHO I and II should have most of their antenatal and intrapartum care at their local hospital, with cardiac reviews in the provider unit they would usually attend for their cardiac care. If this is uncertain or there are concerns in the local hospital, they should be referred to the obstetric cardiology clinic at their local **MMC*** for review or advice.

Women stratified as mWHO II-III should be referred to the obstetric cardiology clinic at their local **MMC*** for MDT consideration about where antenatal and intrapartum care is most appropriately located irrespective of where they usually attend for their cardiac care. For some women, intrapartum care may be appropriate in their local unit.

Women stratified as mWHO III should be referred to the obstetric cardiology clinic at the local **MMC*** for MDT consideration about where antenatal and intrapartum care is most appropriately located irrespective of where they usually attend for their cardiac care.

Women stratified as mWHO IV should be referred to the Obstetric Cardiology Clinic at their local **MMC*** for regional MDT discussion and decision about transfer of antenatal care and delivery. This is to ensure that the team caring for the woman around the time of delivery is familiar with their obstetric and cardiac problems; to provide continuity of care for the woman; and to ensure appropriate co-location of facilities and clinicians. These are the women who are most likely to decompensate and require urgent intervention and/or preterm delivery. It is therefore important that the care of these women is not fragmented across more than one site.

*** In L&SC Obstetric Cardiology referrals for review/advice at the MMC will be led by Blackpool Teaching Hospital**

Detailed advice about the management of individual cardiac conditions can be found within the European Society of Cardiology (ESC) guidelines. However, antenatal monitoring for women with known cardiovascular disease is primarily aimed at detecting deteriorating ventricular function, arrhythmias, worsening valvular function or increasing risk of aortic dissection. To this end, an echocardiogram and an ECG should be performed at each obstetric cardiology clinic visit (unless deemed unnecessary), with other investigations being organised as clinically indicated.

Routine antenatal care must also be conducted in the MMC Obstetric Cardiology clinic unless the woman has received this locally.

At each appointment women must be offered ongoing opportunities for information and education with input from maternal medicine specialist midwives where possible.

## Pre-pregnancy Counselling and Support

Pre-conceptual appointments should be offered to:

- Any woman who is, or who should be, under regular cardiological review
- Any woman planning to undergo assisted reproduction who has significant risk factors for cardiac disease
- Any woman with a family history or genetic confirmation of an inherited cardiac condition (cardiomyopathy, aortopathy, channelopathy) (MBRRACE 2019)

NB Members of the women's family should not be used as interpreters during pre-conceptual consultations

**The pre-pregnancy consultation should include:**

- Assessment and information gathering
- Previous cardiac history, obstetric history and co-morbidities
- Assessment of current functional status (history, echo, ECG and possibly other investigations such as Cardiopulmonary Exercise Testing (CPET), cardiac MRI to facilitate provision of information about pregnancy risks)

**Optimisation**

- Optimise condition – medical, surgical or other interventions
- Lifestyle modification, smoking cessation, folic acid and vitamin D supplementation, reduction in salt intake, consideration of the use of omega 3 supplementation (independent on its use to reduce preterm labour) and reduction or avoidance of alcohol.

**Drugs**
Determine which drugs can be continued in pregnancy and plans for changing any which cannot be used in pregnancy. Some may need to be stopped or changed prior to pregnancy and the woman reassessed after stopping them.

Refer to the ESC guidelines 2018 as referenced above for specific information on cardiovascular drugs and safety.

**Information giving**

Give the woman information about the risks to them and the fetus (including morbidity and mortality)

- Discussion of risk of recurrence of cardiac condition in the fetus and the testing currently available
- Outline a plan of management of pregnancy and delivery
- Clear documentation of discussions/information given to the woman to facilitate their decision on whether to proceed or not with a pregnancy
- Discussion around any additional issues around assisted conception treatment where relevant e.g. management of anticoagulation
- Information about appropriate contraception
- Information regarding access to contraception options, termination of pregnancy services and how to access care when pregnant

## Termination of Pregnancy

Rapid access to termination of pregnancy services should be facilitated if, for whatever reason, a woman opts for this. Multidisciplinary care will be necessary for some women around the time of termination of pregnancy. For women with severe forms of cardiac disease, it is important that the termination occurs in an NHS hospital setting, with access to cardiac facilities.

Clinicians should recognise the difficulty in making these types of decisions and be supportive of a decision to abort in the context of significant maternal cardiac disease.

## Miscarriage

The care of women who miscarry requires a multi-disciplinary approach, including the appropriate cardiologist, gynaecologist and anaesthetist (general and/or cardiac as appropriate). The multidisciplinary team should decide the best place and method for management of the woman having a miscarriage. The options for management of the miscarriage are surgical evacuation, medical management or Manual Vacuum Aspiration (MVA). These all have their own risks and benefits, particularly in the context of cardiac disease. Surgical evacuation requires an anaesthetic but has a lower risk of retained products and the timing is more predictable.

Women having medical management of miscarriage need to be managed as an inpatient with access to senior clinical staff. MVA performed in a theatre setting (but without an anaesthetic) may be a suitable procedure for some women (less than 9 weeks gestation).

If a woman miscarries at home then she should be advised to attend hospital to be assessed.

## Antenatal Care

All cardiac referrals to an MMC can be made through the MMN referral system. Each MMC has their own referral process that can be accessed by following the hyperlinks below.

1. Referral to GMEC MMC at St. Mary's Hospital (Appendix 3)
2. Referral to C&M MMC at Liverpool Women's Hospital (Appendix 4)
3. Referral to L&SC MMC at Royal Preston Hospital (Appendix 5)

Women who have been seen pre-conceptually may access care directly. Some women may contact the cardiology team, or the Cardiac Liaison Nurses who can also refer women directly to the Obstetric Cardiology Clinic, through the referral system.

Any woman who gives a history at booking of known or suspected heart disease (or aortic disease) should be referred as early as possible for review with an obstetrician to determine their level of risk, and whether onward referral is necessary.

Antenatal appointments for women with cardiac disease should provide care specifically for women with cardiac disease, in addition to the care provided routinely for healthy pregnant women. Table 2 below describes where care for women with cardiac disease differs from routine antenatal care.

All professionals must document their consultations in the woman's personally accessed maternity record as well as maintaining contemporaneous hospital records.

**Table 2: Specific antenatal care for women with cardiac disease**

| Appointment | Care for women with cardiac disease during pregnancy |
|---|---|
| First appointment | • Take a full clinical assessment to establish the extent of cardiac-related disease<br>• Identify baseline investigations required<br>• Review risk factors and functional status<br>• Review medications for cardiac disease and its complications<br>• Identify obstetric cardiac risk<br>• Offer information, advice and support<br>• Discuss option of termination with women with extremely high-risk cardiac disease<br>• Refer as necessary to Obstetric Cardiology clinic at local unit<br>• Refer as necessary to local MMC (Appendix 3-5) |
| By 10-weeks | • Completion of all first appointment requirements (as above)<br>• Confirm viability of pregnancy |

| | |
|---|---|
| | • Discuss information, education and advice about how cardiac disease will affect the pregnancy, birth and early parenting (such as breastfeeding and initial care of the baby) |
| By 21 weeks | • Offer fetal echocardiogram to women with structural congenital heart disease |
| Number and timing of further appointments will be dependent on the nature and severity of cardiac disease. Some appointments may be with the local multidisciplinary maternity team, community midwife or maternal medicine midwife. | • Start routine tests of fetal-wellbeing for women with cardiac disease who are awaiting spontaneous labour, or offer caesarean section if indicated<br>• Refer all women with mWHO II – IV cardiac disease to an anaesthetist<br>• Involve other members of MDT as appropriate<br>• Offer information and advice about:<br>○ timing, mode and management of birth<br>○ analgesia and anaesthesia<br>○ fluid balance<br>○ medication<br>○ need for invasive maternal monitoring and postnatal management<br>○ management of the baby after birth<br>○ initiation of breastfeeding and the effect of medication on breastfeeding<br>○ contraception and follow-up postnatally |

**Additional antenatal considerations**

All women with confirmed cardiac disease must be referred to the obstetric anaesthetist at the unit in which their intrapartum care is planned.

Women with inherited cardiac conditions must be referred to the genetics team as they may be offered prenatal diagnosis and the baby will need follow up.

Women with cardiac disease must be offered lifestyle advice and management as appropriate, including counselling/psychology support, dietetics and smoking cessation.

Women who live far away from the hospital may need to be given the option of induction of labour to reduce the need to travel a long distance whilst in labour. This should be discussed as part of the women's care plan.

High risk women (and some moderate risk women) (mWHO III and above) must be discussed at the appropriate MMC MDT meeting.

For all moderate and high risk women, individual care plans for the pregnancy and birth must be formulated and documented on a standard proforma (Appendix 6). This should be disseminated widely to all members of the multidisciplinary team, including those in the local hospital and a copy filed in the woman's hospital notes (digital and handheld notes).

**Pharmacological assessment**

As with all women, the benefits of any drug given during pregnancy must outweigh the risks.

Drugs with significant risks for the fetus in pregnancy are:

- Warfarin – teratogenic and fetotoxic (intracranial haemorrhage)
- ACE inhibitors and ARBs– teratogenic and fetotoxic (renal impairment)
- Amiodarone – sustained use may cause fetal thyroid goitre

Drugs with potential risks for the fetus in pregnancy are:

- Statins - may impair myelination and neurodevelopment (no conclusive data)
- Beta blockers – no teratogenic effect, possible growth restriction (benefit usually outweighs risk). Women taking beta blockers peri-partum need to be aware of the risk of neonatal hypoglycaemia and the need for neonatal glycaemic surveillance.

All women with cardiac disease who are taking **warfarin**, **ACE inhibitors**, **ARB**s or **amiodarone** must be referred urgently to the Obstetric Cardiology Clinic at an MMC as soon as they present in pregnancy.

**Fetal Screening for congenital malformations (by 20+6 weeks gestation)**

Anyone with structural congenital heart disease have an increased risk of having a baby with congenital heart disease. Pregnant women with congenital heart disease, or whose partners have congenital heart disease, should be offered a fetal echocardiogram antenatally.

Anyone with functional congenital heart disease (i.e. patent ductus arteriosus (PDA), patent foramen ovale (PFO), atrial septal defect (ASD)) do not need fetal echocardiogram for their pregnancies as these conditions cannot be diagnosed antenatally.

Women with acquired heart disease or inherited cardiac conditions with a structurally normal heart (Marfan's, long QT syndrome) do not need fetal echocardiography.

Fetal echocardiogram must be performed by experienced fetal echocardiographers where prognosis and management can be discussed in detail with the woman and their family if an abnormality is detected (BCCA guideline 2012).

The fetal echocardiogram should be performed by 20+6 weeks gestation. A decision may be made to perform it earlier at times. Referral for fetal echocardiogram should follow the existing local referral pathways. If the fetus is found to have congenital heart disease a referral should be made to the Fetal Medicine Unit at the appropriate MMC who must co-ordinate the subsequent management of the fetus according to Fetal Anomaly Screening Programme (FASP Guidelines) and regional guidelines.

**Monitoring fetal growth and wellbeing**

Women who are cyanosed are at risk of Fetal Growth Restriction (FGR) and fetal growth and wellbeing should be monitored regularly.

Beta blockers are often a useful drug in pregnancy but may be associated with a small increased risk of FGR. The clinician should be aware of this increased risk and arrange regular growth scans.

**Escalation and Transfer**

Women booked in a local provider unit may have newly diagnosed cardiac disease in pregnancy or worsening of pre-existing cardiac disease. This may precipitate a request for their care to be transferred to the appropriate MMC. A consultant to consultant discussion

should take place to decide appropriate timing of transfer (e.g. routine, urgent, emergency) and transport needs (e.g. own car; ambulance with or without accompanying trained/experienced staff from the transferring hospital, or paramedic ambulance) appropriate to clinical need. This can be arranged by contacting the consultant obstetrician on duty at the MMC or by contacting the specialist physicians and obstetricians at each appropriate centre (Appendix 3-5).

All relevant documentation/information should be communicated from the referring hospital to the receiving hospital and sent in full with the woman (including the woman's records/clinical notes).

Agreement of the woman to transfer must be documented. In emergency situations when a woman is unable to agree to transfer, where possible, the next of kin should be informed of the decision to transfer. The responsibility for transfer rests with the consultant in charge of the woman's care in the referring hospital.

## Intrapartum Management

All women with pre-existing cardiac conditions who have been discussed at MDT level must follow the MDT care plan (Appendix 6) for intrapartum care.

There is a broad spectrum of types and severity of cardiac disease in pregnancy; one protocol is not appropriate for all women. The following principles apply to the management of most women with anything more than mild (mWHO I) cardiac disease:

For the most severe cardiac conditions as outlined in mWHO III- IV the place of birth will be decided by the MDT caring for the woman.

**Senior input and multidisciplinary care are imperative**
The consultant obstetrician, consultant anaesthetist, midwife in charge on labour ward and possibly cardiologist, intensive care and neonatal consultants should be informed of the woman's admission. This should be outlined on the care plan.

**Facilities**
If a woman is being induced, the care plan should specify whether the induction can be performed on an antenatal ward / induction suite or whether it should be done on the consultant led labour ward. Women in labour, or women being induced who are suitable for amniotomy should be cared for on the consultant led labour ward. Women with moderate or high-risk cardiac conditions require High Dependency Care on the labour ward.

Minimising any additional load on the cardiovascular system is usually best achieved by aiming for the spontaneous onset of labour. If labour is induced, normal induction regimes can be used but consideration may need to be given to volume restricting Oxytocin infusions if they are used.

**Supine hypotension must be avoided**
If a woman is lying down, they should be encouraged to lie on their side or be effectively wedged. Uterine displacement should be used in all cases of maternal collapse or resuscitation.

**Anticoagulation**
Most women with cardiac disease who require anticoagulation are managed on subcutaneous low molecular weight heparin throughout pregnancy, with close monitoring of Anti Xa levels. There should be an Obstetric Haematology care plan for peripartum anticoagulation management. If not stated, or no care plan has been completed, the consultant haematologist should be contacted when the woman is admitted.
If the woman requires birth while on warfarin, contact the consultant haematologist immediately for advice. Clopidogrel is a platelet aggregation inhibitor. Due to the irreversible binding of platelets, effects can last 7-10 days after exposure Aspirin does not usually cause problems with surgical haemostasis.

Women with cardiac disease who are anticoagulated are at risk of bleeding and haematoma formation. There should be meticulous attention to haemostasis whether this is at caesarean section or after a vaginal birth. Perineal trauma must be repaired by a senior operator.

**Analgesia**
Women with cardiac disease should see the obstetric anaesthetist antenatally to discuss analgesia. When a woman with cardiac disease is admitted to the Delivery Unit the anaesthetic staff should have early involvement. Whilst any form of analgesia is suitable for women with mild (mWHO I) disease, epidural analgesia has particular benefits for women with more severe disease. It provides effective analgesia, greater cardiovascular stability and facilitates a longer passive second stage prior to active pushing; and is useful should assisted vaginal birth or caesarean section be needed.

**Fluid balance**
Accurate assessment in all women with cardiac disease. Large fluid shifts occur around the time of the birth. Hypotension due to hypovolaemia is dangerous for women with some types of cardiac disease, for example aortic stenosis. For many women with cardiac disease fluid overload could precipitate heart failure. Intravenous fluid must be given via volumetric pump to facilitate accurate input control and recording. An hourly input/output chart and hourly urometer should be used in high-risk cases. An arterial line and/or central venous access may be indicated and this will be specified in the anaesthetic care plan. Blood loss should be assessed as accurately as possible, by weighing swabs and pads, etc. There should be meticulous attention to haemostasis.

**Meticulous care**
Must be taken to avoid air embolism through intravenous lines particularly if there is a right to left circulatory connection (e.g. ASD). Air embolism is prevented by using bubble traps / filters on all intravenous lines such as those ‘built into’ electronic pumps. Volumetric pumps must therefore be used whenever possible for women with cardiac disease.

**Blood Pressure Control**
For some cardiac conditions hypotension is poorly tolerated. Prompt and accurate replacement of lost volume is necessary. Vasoactive medications e.g. nifedipine should be used with extreme care and only after discussion with a consultant. Oxytocin may also cause hypotension and should be given cautiously (see below).
For other cardiac conditions, hypertensive surges may be poorly tolerated.

**Prophylactic Antibiotics**

Current NICE guidelines state that antibiotic prophylaxis against infective endocarditis should not be routinely offered for gynaecological and obstetric procedures or childbirth. Antibiotics should be given for all the usual obstetric indications but with a lower threshold in women who are at increased risk of endocarditis; for example women with prosthetic valves, endocarditis history, valvulopathy.

**Maternal and Fetal Monitoring in Labour**
Pulse, blood pressure, oxygen saturations and respiratory rate should be charted on an HDU chart. Maternal monitoring will be dictated by the nature of the cardiac condition. Women with moderate and high-risk cardiac conditions should be cared for in a High Dependency Area on the Delivery Unit and a HDU chart must be used.
In women with moderate or high-risk cardiac disease, shifts in blood pressure may result in hypoxia. For these reasons, continuous electronic fetal monitoring is recommended.

**Vaginal birth**
For most women with cardiac disease, vaginal birth is the preferred mode of birth, unless patient choice, obstetric or specific cardiac considerations determine otherwise.

**Limitation of active second stage**
If the active second stage is to be limited, allowing maximum descent of the presenting part, by facilitating a two-hour passive second stage is sensible. Epidural analgesia is useful in this context. After 30 minutes of active pushing the woman should be assessed with a view to performing an assisted vaginal birth, unless a spontaneous vaginal birth appears imminent, and they are haemodynamically stable. The increased risk of an assisted vaginal birth and associated increase in risk of perineal trauma and obstetric anal sphincter injury should be explained to women in the birth planning process.

**Caesarean section**
Indications for caesarean section are outlined in Table 3 below. Some women with cardiac conditions pose complex anaesthetic challenges and cannot safely undergo rapid anaesthesia; this should be discussed with the woman antenatally and considered when deciding mode of birth. There should be close communication with the anaesthetic ST3, or above, consultant obstetrician and consultant anaesthetist over any concerns about the fetal condition and the woman's progress through labour to allow for timely preparation and involvement of critical care and cardiac anaesthetic support if appropriate. If the woman has been seen antenatally by the anaesthetist there should be a plan documented in the records. Women with moderate or high-risk cardiac lesions, who require emergency caesarean section should be made aware that the decision-to-delivery may be prolonged, as the priority is to maintain maternal safety, and a longer anaesthetic time may be needed.

**Table 3 Indications for Caesarean**

| **INDICATIONS FOR CAESAREAN SECTION** | |
|---|---|
| Cardiac Indicators* | Obstetric Indicators |
| Poor ventricular function<br>Cyanotic heart disease or pulmonary hypertension<br>Myocardial ischaemia<br>Severe aortic or mitral valve stenosis<br>Dilated aortic root | Any obstetric indicators as per local hospital guidelines |

| |
|---|
| ***** *any cardiac condition where there is limited ability to increase* cardiac output safely |

**Premature Labour**
Tocolytics should not be commenced without prior discussion with the consultant obstetrician, ideally with an obstetrician or physician with an interest in maternal medicine as they may severely compromise cardiac function, especially nifedipine. Atosiban has the least cardiovascular side effects of all the tocolytics and is the tocolytic of choice for women with severe cardiac disease. If it is unavailable, then the consultant obstetrician on call should be contacted and their advice taken on the choice of tocolytic. Steroids for fetal lung maturity are not contraindicated. Magnesium sulphate infusions for neuroprotection can also be used but may cause hypotension, so should be used with care and frequent blood pressure monitoring.

**Third Stage**
Oxytocic drugs require caution in some women with cardiac conditions as they cause vasodilation and hypotension, often with a reflex tachycardia. Examples of conditions in which this would be undesirable are women with fixed cardiac output such as mitral or aortic stenosis, hypertrophic cardiomyopathy, poor ventricular function or ischaemic heart disease. For women with moderate or severe cardiac conditions, Oxytocin should be given as a slow bolus intravenously (Oxytocin 5 units in 20 ml of Sodium Chloride 0.9% over 20 minutes via an infusion pump). In cases where there is uncertainty about what to use for the third stage of labour, then this regime should be used as it has the least vasoactive side effects.

## Early Postnatal Care

**Uterine hypotonia**
Oxytocin infusions can be used although in some women the volume of fluid may need to be limited (i.e. 40 units oxytocin in 36 ml NaCl 0.9% administered at 10ml/hour). Mechanical methods such as bimanual compression, B-Lynch suture and Bakri balloon can also be used in problematic hypotonia. Oxytocin boluses require caution as above and should be given slowly. Ergometrine may cause hypertension and/or increase venous return, which is undesirable in patients with poorly functioning ventricle or aortopathy. Prostaglandin analogues such as carboprost, increase pulmonary vascular pressure so should be avoided in patients with pulmonary hypertension. Misoprostol (1000 micrograms rectally or 800 micrograms sublingually) may be considered as an alternative to carboprost (Haemobate), since the former is less vasoactive. If a woman is becoming unstable due to massive haemorrhage from hypotonia, then oxytocin can be used as the hypertensive surge is not pertinent in this situation. In women who have needed anticoagulation in pregnancy, consider a haematology opinion prior to giving tranexamic acid.

**Postnatal Monitoring**
This is often a time of decompensation, hence observation in Obstetric HDU (or a planned admission to Level 3 ICU care) is appropriate for women with moderate or high-risk cardiac lesions. STRICT fluid balance should be monitored closely. Heart failure is a particular concern due to fluid shifts within the first 24 hours postnatal, and staff should not become complacent just because birth has been successfully achieved. An HDU chart should be used. An extended postnatal stay may be indicated. The woman's cardiovascular system should be assessed daily until they leave hospital.

**Thromboprophylaxis**
Women with cardiac disease who have had a caesarean section should receive low molecular weight heparin thromboprophylaxis. Low molecular weight heparin should not be commenced until 4-hours after removal of an epidural catheter or insertion of a spinal anaesthetic.
Thromboprophylaxis in other circumstances is not contraindicated in women with cardiac disease and should follow local thromboprophylaxis guidelines.

**Pharmacological Assessment**
All cardiac medication should be reviewed postpartum as drugs and doses may need changing. Any medication which was discontinued before/during pregnancy may need restarting, taking account of whether the woman is breastfeeding. Warfarin and ACE inhibitors can be used when breastfeeding. Single doses of amiodarone are unlikely to cause neonatal thyroid problems, but sustained use may do and therefore it should be used only when necessary, and with neonatal monitoring. As yet there is insufficient data on the use of newer anticoagulants, e.g. apixaban, in breastfeeding, so alternatives, e.g. warfarin, or LMWH should be used.

## Neonatal Care

Babies of women with heart disease should be cared for in the usual way, in accordance with unit guidelines. Babies of mothers with congenital heart disease have an increased incidence of CHD themselves (3-6%). Women with inherited cardiac conditions may have been in contact with the genetics team during the pregnancy with regards to testing the baby. Sometimes testing of cord blood is arranged, and sometimes testing is arranged when the baby is older. Relevant documentation should be available in the records.

## Contraception

Contraception can be discussed at any clinic visit but it is particularly relevant to pre-pregnancy and postnatal consultations. For some women with heart disease it is important to discuss the option of sterilisation at the time of Caesarean Section during the pregnancy.

For some women with heart disease immediate postpartum contraception with either an (intrauterine device) IUD or long-acting reversible contraceptives (LARC) / progesterone implant is appropriate. This option should be discussed during pregnancy.

Contraceptive options should be discussed with women prior to discharge. Guidance about contraception for women with heart disease is available on the Faculty of Sexual and Reproductive Health website – Contraceptive choices for Women with Cardiac Disease 2014.

Specialist contraception advice may be required for some women. Details for services within each locality can be found in Appendix 7.

## Subsequent Postnatal Care

Women with cardiac disease should be informed about the risks in future pregnancies and the importance of pre-conception care when planning future pregnancies.

Women with pre-existing cardiac disease who have low risk conditions should be referred back to their routine cardiac care arrangements.

**Follow up appointment**

A follow-up review appointment should be arranged for approximately 6 weeks postnatal for those women who fall into the following categories:

| | |
|---|---|
| mWHO I & II | Primary care |
| mWHO II-III and some mWHO III | Primary care/place of birth or Local MMC (clinical opinion) with local cardiac provider |
| mWHO III and IV | Local MMC with local cardiac provider |

At the postnatal appointment in the local MMC there must be:

- Assessment of cardiac status
- Obstetric review
- Discussion of events around the time of birth
- Discussion of future pregnancies and advice regarding pre-pregnancy care
- Discussion of contraception
- Referral back to routine cardiac follow up

## Suspected or Newly Diagnosed Cardiac Disease

Cardiac disease can present for the first time in pregnancy or in the postpartum period. A high index of suspicion is required. In the 2015-17 MBRRACE report 78% of the Women who died from cardiac disease were not known to have pre-existing cardiac disease (MBRRACE-UK, 2019).

Repeated attempts to access medical care, extreme anxiety, a raised respiratory rate, chest pain, persistent sinus tachycardia, unexplained cough, pink frothy sputum and orthopnoea are important signs and symptoms which must always be fully investigated. (MBRRACE-UK 2019, NICE 2019)

The emphasis should be on making a diagnosis, not simply excluding a diagnosis. Troponin and N-terminal pro-brain natriuretic peptide (NT-proBNP) are useful biomarkers in the assessment of women with suspected new onset cardiac disease (NICE 2019). Women should not be denied relevant investigations e.g., chest X-ray, simply because they are pregnant.

Early involvement of senior clinicians from the obstetric and cardiology multidisciplinary team is important.

## Sources of Support

Women should be made aware of sources of support. Women may wish to access support at any stage from the time when they are first considering pregnancy until after the baby is born.

Women with heart disease may have difficult decisions to make and may not always have a successful outcome to the pregnancy.

Women may find access to peer support helpful e.g. British Heart Foundation (BHF) or North West Congenital Heart Network and should be given contact details (Appendix 8).

## Appendix 1: North West Maternity Providers

| LMNS | Cheshire & Merseyside | Greater Manchester & Eastern Cheshire | Lancashire & South Cumbria |
|---|---|---|---|
| **MMC** | Liverpool Women's Hospital NHS FT **works with Liverpool University NHS Foundation Trust to provide join cardiac and obstetric care** | Manchester University NHS FT St Mary's Hospital Oxford Road Campus | Royal Preston Hospital *** In L&SC Obstetric Cardiology referrals for review/advice at the MMC will be led by Blackpool Teaching Hospital** |
| **Provider Trusts** | Countess of Chester Hospital NHS FT<br><br>Mid-Cheshire Hospitals NHS FT (Leighton)<br><br>Mersey and West Lancashire Teaching Hospitals NHS Trust (St Helens & Knowsley)<br><br>Mersey and West Lancashire Teaching Hospitals NHS Trust (Southport & Ormskirk)<br><br>Warrington & Halton Teaching Hospitals NHS FT<br><br>Wirral University Teaching Hospital NHS FT | Bolton FT<br><br>East Cheshire NHS Trust (Macclesfield)<br><br>MFT North Manchester General Hospital<br><br>MFT Wythenshawe<br><br>Northern Care Alliance NHS FT<br><br>Stockport NHS FT<br><br>Tameside & Glossop NHS FT<br><br>Wrightington, Wigan and Leigh NHS FT | East Lancashire Hospital NHS Trust<br><br>University Hospital Morecambe Bay NHS FT (Furness)<br><br>University Hospital Morecambe Bay NHS FT (Lancaster)<br><br>Blackpool Teaching Hospitals NHS FT |

## Appendix 2 Risk Stratification of conditions and location of care

| | mWHO I | mWHO II | mWHO II-III | mWHO III | mWHO IV |
|---|---|---|---|---|---|
| **Diagnosis (if otherwise well and uncomplicated)** | Small or mild<br>- pulmonary stenosis<br>- patent ductus arteriosus<br>- mitral valve prolapse<br>Successfully repaired simple lesions (atrial or ventricular septal defect, patent ductus arteriosus, anomalous pulmonary venous drainage)<br>Atrial or ventricular ectopic beats isolated | Unoperated atrial septal or ventricular defect<br>Repaired tetralogy of Fallot<br>Most arrhythmias (supraventricular arrhythmias) | Mild left ventricular impairment (EF >45%)<br>Hypertrophic cardiomyopathy<br>Native or tissue valve disease not considered WHO I or IV (mild mitral aortic stenosis)<br>Marfan or other HTAD syndrome without aortic dilatation<br>Aorta <45 mm in bicuspid aortic valve pathology<br>Repaired coarctation<br>Atrioventricular septal defect<br>Turners Syndrome<br>All channelopathies (event rate not applicable) | Moderate left ventricular impairment (EF 30-45%)<br>Previous peripartum cardiomyopathy without any residual impairment of left ventricular function<br>Systemic right ventricle with good or mildly decreased ventricular function<br>Fontan circulation. If otherwise the patient is well and the cardiac condition uncomplicated<br>Unrepaired cyanotic heart disease<br>Other complex heart disease<br>Moderate mitral stenosis<br>Severe asymptomatic aortic stenosis<br>Moderate aortic dilatation<br>Ventricular tachycardia | Pulmonary arterial hypertension (managed in Sheffield PH service)<br>Severe left ventricular dysfunction (EF <30% or NYHA class III-IV)<br>Previous peripartum cardiomyopathy with any residual left ventricular impairment<br>Severe mitral stenosis<br>Severe symptomatic aortic stenosis<br>Systemic right ventricle with moderate or severely decreased ventricular function<br>Severe aortic dilatation<br>Vascular Ehlers-Danlos<br>Severe (re)coarctation<br>Fontan with any complication<br>Mechanical valve |

| | mWHO I | mWHO II | mWHO II-III | mWHO III | mWHO IV |
|---|---|---|---|---|---|
| Risk | No detectable increased risk of maternal mortality and no/mild increased risk in morbidity | Small increased risk of maternal mortality or moderate increase in morbidity | Intermediate increased risk of maternal mortality or moderate to severe increase in morbidity | Significantly increased risk of maternal mortality or severe morbidity | Extremely high risk of maternal mortality or severe morbidity |
| Maternal cardiac event rate | 2.5-5% | 5.7-10.5% | 10-19% | 19-27% | 40-100% |
| Pre-pregnancy Counselling | Optional- local unit | Yes-local unit | Yes- local unit | Yes: expert counselling required | Yes: expert counselling required |
| Care during pregnancy | At the Local hospital. If there are concerns, or a lack of expertise or timely review in the local hospital, refer to the obstetric cardiology clinic at the local **MMC*** for review or advice. | At the Local hospital. If there are concerns, or a lack of expertise or timely review in the local hospital, refer to the obstetric cardiology clinic at the local **MMC*** for review or advice. | Refer to the Obstetric Cardiology Clinic at the local **MMC*** for MDT consideration about where antenatal care and delivery is most appropriately located irrespective of where they usually attend for their cardiac care.<br><br>For some women, delivery may be appropriate in their local unit. | Refer to the Obstetric Cardiology Clinic at the local **MMC*** for MDT consideration about where antenatal care and delivery is most appropriately located irrespective of where they usually attend for their cardiac care. | Refer to the Obstetric Cardiology Clinic at their local **MMC*** for regional MDT discussion and decision about transfer of antenatal care and delivery.<br><br>**Pulmonary Hypertension cases discussed in MMC MDT -managed in Sheffield PH Service** |
| Minimal follow-up visits during pregnancy | Once or twice | Once per trimester | Bimonthly | Monthly or Bimonthly | Monthly |
| Location of delivery | Local hospital | Local Hospital or Individualised assessment after MDT review | Individualised assessment after MDT review | Expert centre for pregnancy and cardiac disease as decided at MMC MDT review | Expert centre for pregnancy and cardiac disease as decided at MMC MDT or Regional MDT |

***In L&SC Obstetric Cardiology referrals for review/advice at the MMC will be led by Blackpool Teaching Hospital**

## Appendix 3: GMEC Referral process to St Mary's Manchester MMC

| GMEC MMC at St Mary's Hospital | |
|---|---|
| MDT co-ordinator (Mon-Fri 8-4) | 0161 271 3593<br>maternal.medicine@mft.nhs.uk |
| EMERGENCY ADVICE | On call Consultant Obstetrician: Switchboard: 0161 2761234 ask for Obstetric Consultant on call Bleep Bleep 6000 or via Vocera. (On call Consultant should inform a member of the obstetric cardiac team during working hours)<br><br>On call Cardiology registrar/consultant MRI: 0161 2741234 |
| Referral form | MFT Maternal Medicine Referral Form (office.com) |

## Appendix 4: C&M Referral to Liverpool Women's MMC

| C&M MMC at Liverpool Women's Hospital | |
|---|---|
| MDT co-ordinator (Mon-Fri 8-4) | 0151 702 4271<br>maternal.medicine@lwh.nhs.uk |
| EMERGENCY ADVICE | For **unwell women where transfer of care** to MMC is being considered or delivery may be indicated this should go through on call obstetric consultant at MMC (switchboard 0151 708 9988 ask for Obstetric Consultant on call) who will facilitate an MDT discussion with Cardiology Consultant, anaesthetic and neonatal teams, to determine appropriate location of ongoing care.<br><br>For admitted unwell women in spoke hospitals the referral pathway should continue with the usual escalation and review by onsite cardiology<br>- if the woman requires ongoing follow up a referral through the portal should be made for opinion and review as appropriate<br><br>**All cases should have a referral form completed through the MMC.** |
| Referral form | https://tinyurl.com/LWHMatMedReferral |

## Appendix 5: L&SC Referrals to Royal Preston Hospital MMC and Blackpool Teaching Hospital

Referrals to L&SC should be referred to L&SC MMC via the badgernet Maternal Medicine referral form or via email to maternal.medicine@lthtr.nhs.uk. The MDT co-ordinator will liaise with the specialist teams (at Royal Preston Hospital and Blackpool) to ensure the referral is actioned and an appropriate review is undertaken (either via MDT discussion or face to face review).

| L&SC MMC at Royal Preston Hospital | |
|---|---|
| MDT co-ordinator (Mon-Fri 8-4) | 01772 524730<br>maternal.medicine@lthtr.nhs.uk |
| EMERGENCY ADVICE | On call Consultant Obstetrician at Preston: Switch board 01772716565 Bleep 4371<br>On call Consultant Obstetrician at Blackpool: Switch board 01253 300000<br><br>On call Cardiologist at Preston: Normal working hours switch board 01772716565<br><br>On call Cardiologist at Blackpool: Switchboard 01253 300000 |
| Referral form | For patients on BadgerNet use Maternal Medicine referral form in each patient's notes<br>For Patients not on BadgerNet email maternal.medicine@lthtr.nhs.uk<br>For preconception patients use Advice and Guidance system |

## Appendix 6: Care Plan Templates (optional use)

### Patient summary template

Generic%20Patient%20Summary.docx

### Patient Summary at referral

| | |
|---|---|
| **Referrer name:** | |
| **Job role** | |
| **Referring organisation** | |

| | |
|---|---|
| **Date** | **Patient Details:** |
| **Parity** | |
| **Relevant Obstetric History** | |
| **Current gestation** | |
| **BMI** | |
| **First language** | **Interpreter required Yes No (please circle)** |
| **EDD** | |
| **Next appointment** | |
| **Condition & reason for referral** | |
| **Diagnosis/Interventions** | |
| **Current status of condition** | |
| **Relevant Medical/Anaesthetic History** | |

| | |
|---|---|
| **Medication / Allergies** | |
| **Thromboprophylaxis** | |
| **Patient individual preferences/comments** | |

## MDT summary template

Generic%20MDT%20Summary.docx

## MDT Summary

| | |
|---|---|
| **Name** | |
| **DOB** | |
| **Hospital No** | |
| **MDT attendees** | |
| **Diagnosis**<br>Include: Parity, Condition, Medication | |
| **Investigations** | |
| **MDT Discussion** | Plan:<br>Actions:<br>Outcome: |
| **Antenatal Plan** | |
| **Intrapartum recommendations**<br>**(include place of delivery)** | |
| **Postpartum recommendations** | |
| **Anaesthetic considerations** | |
| **Neonatal considerations** | |
| **Outstanding actions/investigations** | |

| | |
|---|---|
| **Plan in the event of an emergency** | |
| **Contact details** | Generic MMC e-mail:<br>MMC midwife:<br>MDT co-ordinator: |

## Birth Plan template

Generic%20Birth%20Plan.docx

## Birth Plan

| | | |
|---|---|---|
| **Patient Name:** | | |
| **Hospital & NHS Number:** | | |
| **Address** | | |
| **Date of Birth** | | |
| **Allergies:** | | |
| **Condition/Diagnosis** | | |
| **EDD** | | |
| **Obstetric History (Including CS)** | | |
| **Medical/Surgical History** | | |
| **Medications** | | |
| **Planned mode of delivery**<br>**(date of elective C/S or IOL if applicable)** | | |
| **Staff alert:**<br>On call Consultant Obstetrician and Labour ward coordinator to be informed on admission for all Red and Amber patients | | Please circle the tick as appropriate<br>✓ Red Cat A: inform all on call staff immediately on admission, immediate HDU care<br>✓ Amber Cat B: Inform on call team within 4 hours<br>✓ Green Cat C: routine care with attention to care plan |
| **Haemodynamic Goals** | | |
| **Anaesthetic review recommendations** | | |
| **LSCS** | Indication | If labours spontaneously |

| | | |
|---|---|---|
| | Location | Location post op |
| **Induction (continued on next page)** | Location- | |
| | Oxytocin regime | |
| | Considerations/recommendations:<br>-Fluids<br>-Additional monitoring & frequency<br>-Thromboprophylaxis plan | |
| **Vaginal delivery** | Special considerations/recommendations:<br>First stage –<br>Second stage – | |
| **Third stage** | Usual management or other recommendations:<br>Drugs to be used with caution: | |
| **Post-delivery Please Circle as appropriate and add comments** | ICU | Yes / No |
| | Stay on labour ward (how long?) | Yes / No |
| | Stay in hospital (how long?) | |
| | Medication plan (breastfeeding considerations) | |
| | Daily examination by Doctor - | Yes / No |
| | State investigations before discharge | |
| | Thromboprophylaxis | Yes / No<br>Dose & Duration |
| | PN follow arranged/planned | Yes / No |
| **Contact Details** | Generic MMC e-mail: | |
| | MMC midwife: | |

| | | |
|---|---|---|
| | MDT co-ordinator: | |

## Appendix 7: Contraception

| | |
|---|---|
| **Greater Manchester and Eastern Cheshire** | Sexual and Reproductive Health team at The Hathersage Centre on telephone no. 0161 701 1555<br>Alternatively, patients can identify their nearest clinic using the following link https://mft.nhs.uk/mri/services/northern-sexual-health-service/ |
| **Cheshire and Merseyside** | Specialist contraceptive advice can be obtained through Axess sexual health clinic (0300 323 1300).<br>Patients with a Liverpool GP can also self-refer to the PCN hub (clpcn.co.uk).<br>Alternatively, patients can identify their nearest clinic using the following link https://www.axess.clinic/find-service/ |
| **Lancashire and South Cumbria** | Patients can identify their nearest clinic using the following link https://lancashiresexualhealth.nhs.uk/find-nearest-centre/ |

## Appendix 8: Support groups for Women with Cardiac Disease

| | |
|---|---|
| **British Heart Foundation**<br>Website: www.bhf.org.uk | |
| **Somerville Foundation**<br>Support for young people and adults with congenital heart disease<br>Website: https://thesf.org.uk/ | |
| **North West Congenital Heart Network**<br><br>Website:<br>https://www.northwestchdnetwork.nhs.uk/ | |
| **NW MMN**<br><br>Website:<br>https://nwmaternalmedicinenetwork.org.uk/ | |

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