
بسم الله الرحمن الرحيم


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مقدمه

- ✓ طی سالهای اخیر مرگ و میر مادران به دلیل بیماریهای قلبی در کشور تقریبا ۱۶درصد بوده که بسیاری از آنها قابل پیشگیری بوده اند. این امر بیانگر نیاز ارائه دهندگان خدمت به یک راهنمای بالینی در مورد شناسایی مادران مبتلا و نحوه مراقبت از آنها است.
- ✓ هدف از دستور عمل حاضر این است که در هر یک از مقاطع پیش از بارداری تا پس از زایمان، زنان مشکوک یا مبتلا به بیماری قلبی به موقع شناسایی شده، به متخصص قلب ارجاع شوند و مراقبت مطلوب و مورد نیاز برای آنان انجام شود تا عوامل قابلاجتناب منجر به ایجاد عوارض یا مرگ مادر به حداقل برسند.
- ✓ اختلالات قلبی با شدتهای متغیر تقریبا در ۲- ۱ درصد حاملگی ها دیده می شود و دخالت چشمگیری در میزان موربیدیتی و مرگ و میر مادری دارند.

جدول سه– طبقه بندی اصلاح شده سازمان جهانی بهداشت برای تعیین خطر بیماریهای قلبی

(با استفاده از منبع European Society of Cardiology)

کلاس ۱ سازمان جهانی بهداشت Conditions in which 1 pregnancy risk is WHO	ضایعات قلبی	فواصل پیگیری با توجه به نظر تیم مراقبت قلب و بارداری
در این شرایط افزایش خطر مرگ مادر وجود ندارد، عوارض وجود ندارد یا کم است . 2.5/5%	• موارد زیر با درجات خفیف، کم یا بدون عارضه: ○ تنگی پولمونر ○ مجرای شریانی باز ○ پرولاپس میترال • ترمیم موفق ضایعات ساده زیر : ○ نقص دیواره دهلیزی یا بطنی ○ مجرای شریانی باز ○ آنومالی در درناژ ورید ریوی • ضربان خارج دهلیزی یا بطنی به تنهایی ایزوله	یک یا دوبار در حاملگی
کلاس ۲ سازمان جهانی بهداشت (if otherwise well and uncomplicated) WHO 2		
در این شرایط خطر مرگ کمی افزایش اما احتمال عوارض تا حد متوسط افزایش می یابد 5.7/10.5%	• موارد زیر در صورتی که شرایط مناسب و بدون عارضه باشد : ○ نقص دیواره بطنی یا دهلیزی جراحی نشده ○ تترالوژی فالوت ترمیم شده	هر تریمستر یک بار
کلاس ۲ تا ۳ سازمان جهانی (با توجه به وضعیت بیمار(depending on individual) WHO 2 – 3)		
10/19%	• اختلال خفیف در عملکرد بطن چپ • کاردیو میوپاتی هیپتروفیک • بیماری مادر زادی دریچه ای یا نسج دریچه که در طبقه بندی یک یا چهار سازمان جهانی بهداشت قرار نمیگیرد • سندروم مارفان بدون دیلاتاسیون • قطر آئورت کمتر از ٤٥ میلیمتر (در بیماری آئورت مرتبط با دریچه دولتی آئورت) • کوآرکتاسیون ترمیم شده	هر دو ماه تا یک ماه

کلاس ۳ سازمان جهانی بهداشت		
در این شرایط خطر مرگ و یا عوارض بطور قابل توجهی افزایش می یابد . مشاوره تخصصی لازم است . در صورت بارداری مراقبت تخصصی متخصصین قلب و زنان در طی بارداری، زایمان و پس از زایمان لازم است 19/27%	• دریچه مصنوعی مکانیکی • بطن راست سیستمیک • گردش خون فونتان • بیماری های سیانوتیک قلب(ترمیم نشده) • سایر ناهنجاری های مادر زادی عارضه دار • دیلاتاسیون آئورت ۴۵-۴۰ میلیمتر در سندرم مارفان • دیلاتاسیون آئورت ۵۰-۴۵ میلیمتر دربیماری آئورتیک مرتبط با دریچه دولتی آئورت	هر یک ماه تا دوماه
کلاس ۴ سازمان جهانی بهداشت Conditions in which pregnancy risk is WHO 4 (pregnancy contraindicated)		
در این شرایط خطر مرگ و یا عوارض افزایش بسیار قابل توجهی دارد . ختم بارداری باید مد نظر باشد اما اگر بارداری ادامه یابد ادامه مراقبت ها مانند کلاس سه انجام شود . 40/100%	• افزایش فشار خون شریانی ریوی به هر دلیل • اختلال عملکرد بطنی شدید سیستمیک (LVEF<30% , NYHA III-IV) • سابقه کاردیومیو پاتی پری پارتوم با هر نوع عملکرد مختل بطن چپ • تنگی شدید میترال ، تنگی شدید علامتدار آئورت • سندرم مارفان با دیلاتاسیون آئورت بیشتر از ۴۵ میلیمتر • دیلاتاسیون آئورت بیشتر از ۵۰ میلیمتر در بیماری آئورت مرتبط با دریچه دولتی آئورت • کوآرکتاسیون شدید مادر زادی	هر یک ماه یا هر ۲ هفته . ممکن است از تریمستر سوم نیاز به بستری باشد

مراقبتهای پیش از بارداری در خانم مبتلا به بیماری قلبی

- ✓ در صورت تشخیص بیماری قلبی، ادامه مراقبتها به شرح زیر انجام و کلیه موارد مکتوب ومستند شود. ضمنا تمام توصیه ها و مشاوره ها ترجیحا باید با حضور همسر انجام شود.
- ✓ در صورتی که مراجعه کننده Case شناخته شده بیماری قلبی است و تحت نظرمتخصص زنان نمی باشد، قبل از اقدام به بارداری باید برای مشاوره به متخصص زنانارجاع شود.
- ✓ فانکشن کلاس قلبی طبق جدول شماره یک ارزیابی و تعیین شود .
- ✓ وضعیت کنونی قلب با اکوکاردیوگرافی و سایر اقدامات تشخیصی ارزیابی شود .
- ✓ متخصص زنان و قلب باید با هم همکاری نزدیک داشته باشند.
- ✓ درمان مطلوب دارویی و یا جراحی تعیین و توصیه شود.

CAD,VHD and Pregnancy

- Dr Pourkia
- Associated Professor of Babol University of Medicine
- Fellowship of Echocardiography

2020 ACC/AHA Guideline for the Management of Patients with Valvular Heart Disease

2021 ESC/EACTS Guidelines for the management of valvular heart disease

ESC European Society of Cardiology
European Heart Journal (2018) **39**, 3165–3241
doi:10.1093/eurheartj/ehy340

ESC GUIDELINES

2018 ESC Guidelines for the management of cardiovascular diseases during pregnancy

دستورالعمل کشوری مراقبت از بیماران قلبی در بارداری، زایمان و پس از زایمان

Coronary artery disease

Case 1

A 42-year-old woman G3 P2 (VD)Ab0 presented with chest pain and ECG change(ACS/STEMI) at 35 weeks of gestation:

Risk factor and Aetiology?

Management??

Delivery time??

Coronary artery disease

Pregnancy ➔ three- to four-fold increase in AMI risk

Risk factors : smoking, maternal age, hypertension, diabetes, obesity, and dyslipidaemia.

Additional risk factors :(pre-)eclampsia, thrombophilia, transfusion, post-partum infection, cocaine use, multiparity, and post-partum haemorrhage.

The aetiology of CAD in pregnancy :the majority of CAD has non-atherosclerotic mechanisms,including pregnancy-related spontaneous coronary artery dissection(P-SCAD) (43%), angiographically normal coronary arteries (18%),and coronary thrombosis (17%).

Management

AMI management: similar general population

Reperfusion:primary PCI in patients with standard indications for revascularization or Recombinant tissue plasminogen activator (subplacental bleeding).

Pharmacotherapy: Low-dose aspirin,Beta-blocker, Clopidogrel (strictly necessary, shortest duration).

Multidisciplinary, including emergency, obstetric, and cardiovascular teams.

Close monitoring of the mother and foetus ➔ delivery strategy if sudden maternal or foetal deterioration.

Maternal cardiac arrest, resuscitation (and delivery) should be performed according to existing guidelines.

Pre-existing CAD

Serious cardiac event ,highest in atherosclerotic,maternal mortality 0/23%,adverse obstetric outcomes16%.

Pregnancy may be considered in patients with known CAD in the absence of residual ischaemia and clinical signs of LV dysfunction.

How long pregnancy should be delayed post-AMI/ACS?
12 month sseems reasonable, individualized according to comorbidities, cardiovascular status, and the requirement for medical therapy.

Labour and delivery

Timing of delivery must be individualized.

However, treatment of STEMI/NSTEMI should not be delayed for delivery.

Delivery should be postponed (if possible) for at least 2 weeks post-AMI to facilitate maternal management.

Vaginal delivery is preferable .

Recommendations for the management of coronary artery disease

Recommendations	Class[a]	Level[b]
ECG and measurement of troponin levels are recommended when a pregnant woman has chest pain.[225,227]	I	C
Primary coronary angioplasty is recommended as the preferred reperfusion therapy for STEMI during pregnancy.[226]	I	C
An invasive management strategy should be considered for NSTE-ACS with high risk criteria.[226]	IIa	C
Conservative management should be considered for stable NSTE-ACS with low risk criteria.	IIa	C
Follow-up should be considered over at least the next 3 months.	IIa	C
Breastfeeding is not recommended in mothers who take antiplatelet agents other than low-dose aspirin due to a lack of data (see section 12).	III	C

Valvular Heart Disease

Case 1

A 30-year-old woman with asymptomatic severe AS intends to become pregnant for the first time.

Questions:

What pre-pregnancy check is needed?

Permission to get pregnant?

Do you need valvular surgery before pregnancy?

Initial Management of Women With VHD Before and During Pregnancy

COR	LOE	Recommendations
1	B-NR	1.Women with suspected valve disease who are considering pregnancy should undergo a clinical evaluation and TTE before pregnancy.
1	B-NR	2. Women with severe valve disease (Stages C and D) who are considering pregnancy should undergo pre-pregnancy counseling by a cardiologist with expertise in managing women with VHD during pregnancy.

Initial Management of Women With VHD Before and During Pregnancy

COR	LOE	Recommendations
1	B-NR	3. Pregnant women with severe valve disease (Stages C and D) should be monitored in a tertiary-care center with a dedicated Heart Valve Team of cardiologists, surgeons, anesthesiologists, and maternal-fetal medicine obstetricians with expertise in the management of high-risk cardiac conditions during pregnancy.
2a	B-NR	4. In asymptomatic women with severe valve disease (Stage C1) who are considering pregnancy, exercise testing is reasonable before pregnancy for risk assessment.

Risk assessment

TTE and Exercise test revealed the following findings :

EF=55% ‘BAV with AVA=0.9cm2’ PAP=30mmHg’No COA’

Ao D=4cm’ No significant abnormality on other valves.

Normal BP response ; No symptom and ST-T change during test

FC=13 METs

Recommendations	Class[a]	Level[b]
Pre-pregnancy evaluation, including echocardiography, and counselling is recommended for any woman with known or suspected valvular disease.	I	C
Aortic stenosis		
Intervention is recommended before pregnancy in patients with severe aortic stenosis if:		
• they are symptomatic	I	B
• OR LV dysfunction (LVEF <50%) is present[204]	I	C
• OR when they develop symptoms during exercise testing.	I	C
Intervention should be considered before pregnancy in asymptomatic patients with severe AS when a fall in blood pressure below baseline during exercise testing occurs.	IIa	C
Balloon aortic valvuloplasty should be considered during pregnancy in patients with severe aortic stenosis and severe symptoms.	IIa	C

Pre-Pregnancy Intervention in Women With VHD

COR	LOE	Recommendations
2a	B-NR	4. In women of childbearing age who require valve replacement, bioprosthetic valves are preferred over mechanical valves because of the increased maternal and fetal risks of mechanical heart valves in pregnancy.
2a	C-EO	5. In asymptomatic women with severe AS (aortic velocity ≥4.0 m/s or mean pressure gradient ≥40 mm Hg, Stage C1) who are considering pregnancy, valve intervention before pregnancy is reasonable.

Intervention During Pregnancy in Women with VHD

COR	LOE	Recommendations
2a	B-NR	1. In pregnant women with severe AS (mean pressure gradient ≥40 mm Hg, Stage D), valve intervention during pregnancy is reasonable if there is hemodynamic deterioration or if there are NYHA class III or IV HF symptoms.
2a	B-NR	2. In pregnant women with severe rheumatic MS (mitral valve area ≤1.5 cm^2, Stage D) and with valve morphology favorable for PMBC who remain symptomatic with NYHA class III or IV HF symptoms despite medical therapy, PMBC is reasonable during pregnancy if it is performed at a Comprehensive Valve Center.
2a	C-LD	3. In pregnant women with severe valve regurgitation and with NYHA class IV HF symptoms (Stage D) refractory to medical therapy, valve surgery is reasonable during pregnancy.
3: Harm	C-LD	4. In pregnant women with VHD, valve surgeries should not be performed in the absence of severe HF symptoms refractory to medical therapy.

Follow up

She comes in at 14 weeks pregnant and asks?

Maternal and fetal complications?

Visiting intervals?

Method of childbirth?

Maternal risk

Cardiac morbidity is related to the baseline severity of AS and symptom

HF: <10% in women with moderate AS and asymptomatic

25% in symptomatic patients.

Arrhythmia and mortality: Rare

Aortic dissection:In BAV and Ao>5cm.

Obstetric and offspring risk

Obstetric complications may be increased in patients with severe AS.

Pre-term birth, intrauterine growth retardation, and low birth weight occur in 20–25% of the offspring of mothers with moderate and severe AS.

Miscarriage and fetal death rates are <5%.

The risk of genetic transmission of LV outflow tract malformations justifies the performance of fetal echocardiography in AS due to BAV.

Follow-up; Labor and delivery

In severe AS, monthly or bimonthly cardiac evaluations including echocardiography are advised.

In severe symptomatic AS, caesarean delivery should be preferred.

An individual approach is recommended for asymptomatic severe AS.

In non-severe AS, vaginal delivery is favored.

Case 2

A 32-year-old woman presented with dyspnea at 25 weeks of gestation.

ECG=AF Rhythm VR=110BPM

TTE: EF=50%; MVA=1.1cm2; sPAP=60mmHg

Questions:

Medical therapy?

Need to intervention?

ACT?

Maternal risk

HF: one-third of pregnant women with a valve area <_1.0 cm2 most often during the second trimester, even in the absence of symptoms before pregnancy.

Sustained AF, although rare (<10%), may precipitate HF and thrombo-embolic events.

Maternal complications risk factors:

NYHA class >= II, systolic PAP >30 mmHg, severe stenosis, and older age

Obstetric and offspring risk

Prematurity rates are 20–30%, intrauterine growth retardation 5–20%, and foetal death 1–5%.

Offspring risk is higher in:

women in NYHA class III/IV during pregnancy.

Medical therapy:

symptoms or clinically significant PH develop: activity should be restricted and beta-1-selective blockers (preferably metoprolol or bisoprolol) commenced.

Diuretics used if symptoms persist avoiding high dose.

Anticoagulation using UFH, LMWH, or VKA: paroxysmal or permanent AF, left atrial thrombosis, or prior embolism.

Anticoagulation should be considered in women:

sinus rhythm with significant MS and spontaneous echocardiographic contrast in the left atrium, large left atrium (>_ 60 mL/m2), or congestive HF

Recommendations for the management of native valvular heart disease

Recommendations	Class[a]	Level[b]
Pre-pregnancy evaluation, including echocardiography, and counselling is recommended for any woman with known or suspected valvular disease.	I	C
Mitral stenosis		
In patients with symptoms or pulmonary hypertension, restricted activities and beta-1-selective blockers are recommended.[5,204]	I	B
Diuretics are recommended when congestive symptoms persist despite beta-blockers.[5]	I	B
Intervention is recommended before pregnancy in patients with MS and valve area <1.0 cm^2.	I	C
Therapeutic anticoagulation using heparins or VKA is recommended in case of atrial fibrillation, left atrial thrombosis, or prior embolism.	I	C
Intervention should be considered before pregnancy in patients with MS and valve area <1.5 cm^2.	IIa	C
Percutaneous mitral commissurotomy should be considered in pregnant patients with severe symptoms or systolic pulmonary artery pressure >50 mmHg despite medical therapy.	IIa	C

Medical Therapy of Pregnant Women with VHD

COR	LOE	Recommendations
2a	C-LD	١. In pregnant women with VHD, beta-blocker medications are reasonable as required for heart rate control or treatment of arrhythmias.
2a	C-LD	2. In pregnant women with VHD and HF symptoms (Stage D), diuretic medications are reasonable if needed for volume overload.
3: Harm	B-NR	3. In pregnant women with VHD, ACE inhibitors and ARBs should not be given because of fetal risk.

Intervention:

During pregnancy, percutaneous mitral commissurotomy is preferably performed after 20 weeks of gestation.

It should only be considered in women with NYHA class III/IV and/or systolic PAP >_50 mmHg, despite optimal medical treatment in the absence of contraindication.

Closed commissurotomy remains an alternative in

low-middle-income countries.

Due to fetal risk, open-heart surgery should be reserved for cases in which all other measures have failed and the mother's life is threatened.

Intervention During Pregnancy in Women with VHD

COR	LOE	Recommendations
2a	B-NR	1. In pregnant women with severe AS (mean pressure gradient ≥40 mm Hg, Stage D), valve intervention during pregnancy is reasonable if there is hemodynamic deterioration or if there are NYHA class III or IV HF symptoms.
2a	B-NR	2. In pregnant women with severe rheumatic MS (mitral valve area ≤1.5 cm^2, Stage D) and with valve morphology favorable for PMBC who remain symptomatic with NYHA class III or IV HF symptoms despite medical therapy, PMBC is reasonable during pregnancy if it is performed at a Comprehensive Valve Center.
2a	C-LD	3. In pregnant women with severe valve regurgitation and with NYHA class IV HF symptoms (Stage D) refractory to medical therapy, valve surgery is reasonable during pregnancy.
3: Harm	C-LD	4. In pregnant women with VHD, valve surgeries should not be performed in the absence of severe HF symptoms refractory to medical therapy.

Case 3

A 25 year-old woman with Hx of Mechanical MVR intends to become pregnant; her INR is in therapeutic range with 5mg warfarin per day.

Questions:

Principles of counseling:

Decide for ACT:

Delivery measures:

Mechanical prostheses and pregnancy

In women with mechanical valves, pregnancy is associated with a very high-risk of complications (WHO risk classification III).

In the ROPAC registry, the chances of an event-free pregnancy :
58% for women with a mechanical valve

79% for women with a bioprosthesis

78% for women with heart disease but no valve prosthesis.

Main risks :

Need for ACT (valve thrombosis and haemorrhagic complications)

Ventricular and valvular dysfunction.

Principles of counseling

The advantages and disadvantages of different anticoagulation regimen should be discussed extensively before pregnancy.

The mother must understand that the use of VKAs is the most effective regimen to prevent valve thrombosis, and therefore the safest regimen for her, and that risks to the mother also jeopardize the baby.

However, the increased risks of embryopathy, foetopathy, foetal loss, and foetal haemorrhage associated with the use of VKAs need to be discussed while considering the VKA dose.

The higher risk of valve thrombosis and lower foetal risks associated with LMWH should be discussed.

Principles of counseling

Risk of valve thrombosis: Warfarin= 0-4%

LMWH= 4.4-8.7%

UFH= 9-33%

Risk of foetal loss : low-dose VKA = 13.4–19.2%, total foetal loss =32.5%.

combined heparin/VKA regimen = 22.7%

LMWH throughout pregnancy = 12.2%

Risk of embryopathy:0.6–10% ;dose dependent(0.45–0.9% with low-dose warfarin)

substitution of VKA with UFH or LMWH in weeks 6–12

Risk of foetopathy : 0.7–2%

Surveillance during pregnancy

The mother should underestand that whatever anticoagulation regime is chosen, her restrict compliance is crucial for a success.

These high-risk pregnancies should be managed by a pregnancy heart team in an expert center.

The effectiveness of the anticoagulation regimen should be monitored weekly or every 2 weeks depending on the anticoagulation regimen.

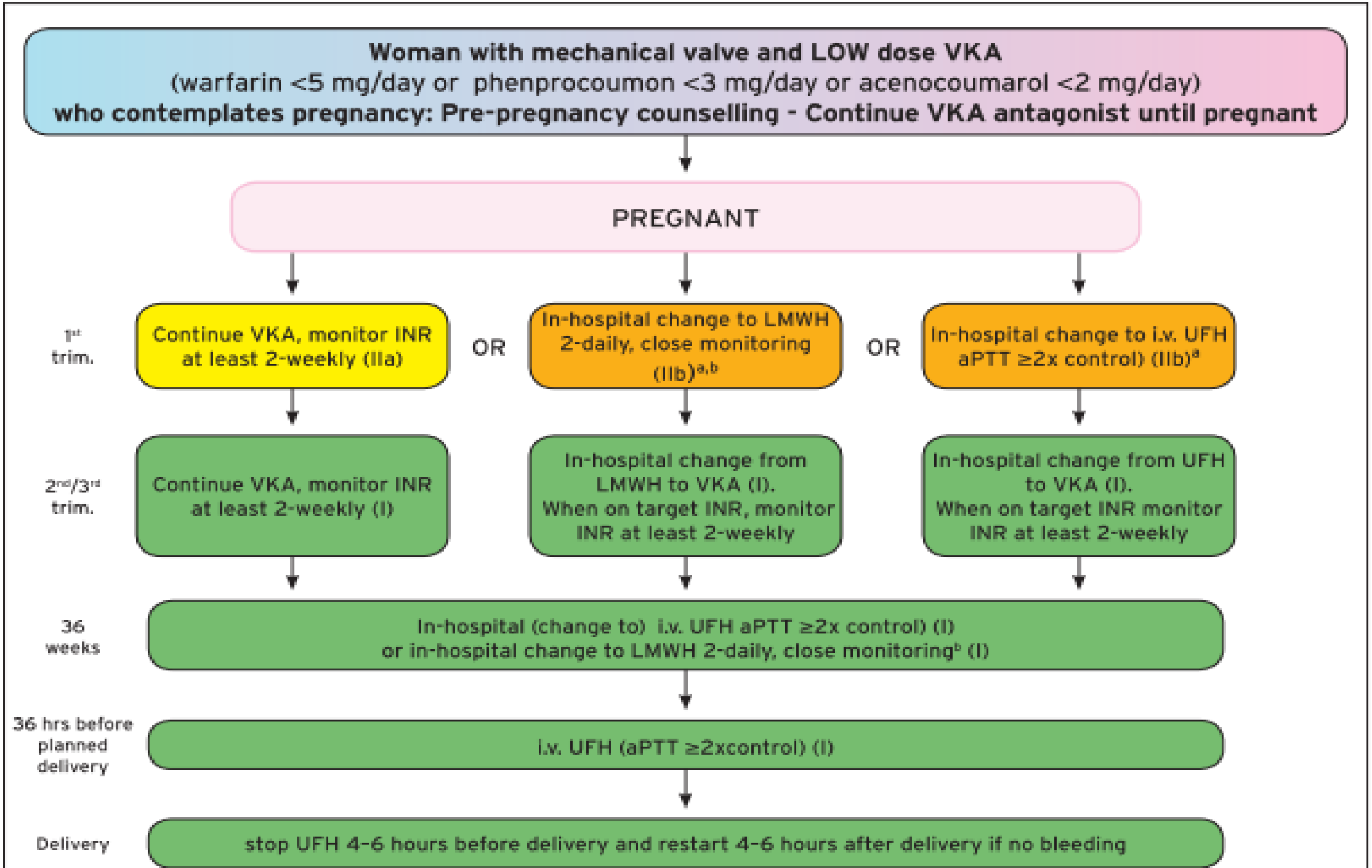
Clinical follow-up including echocardiography should be performed monthly.

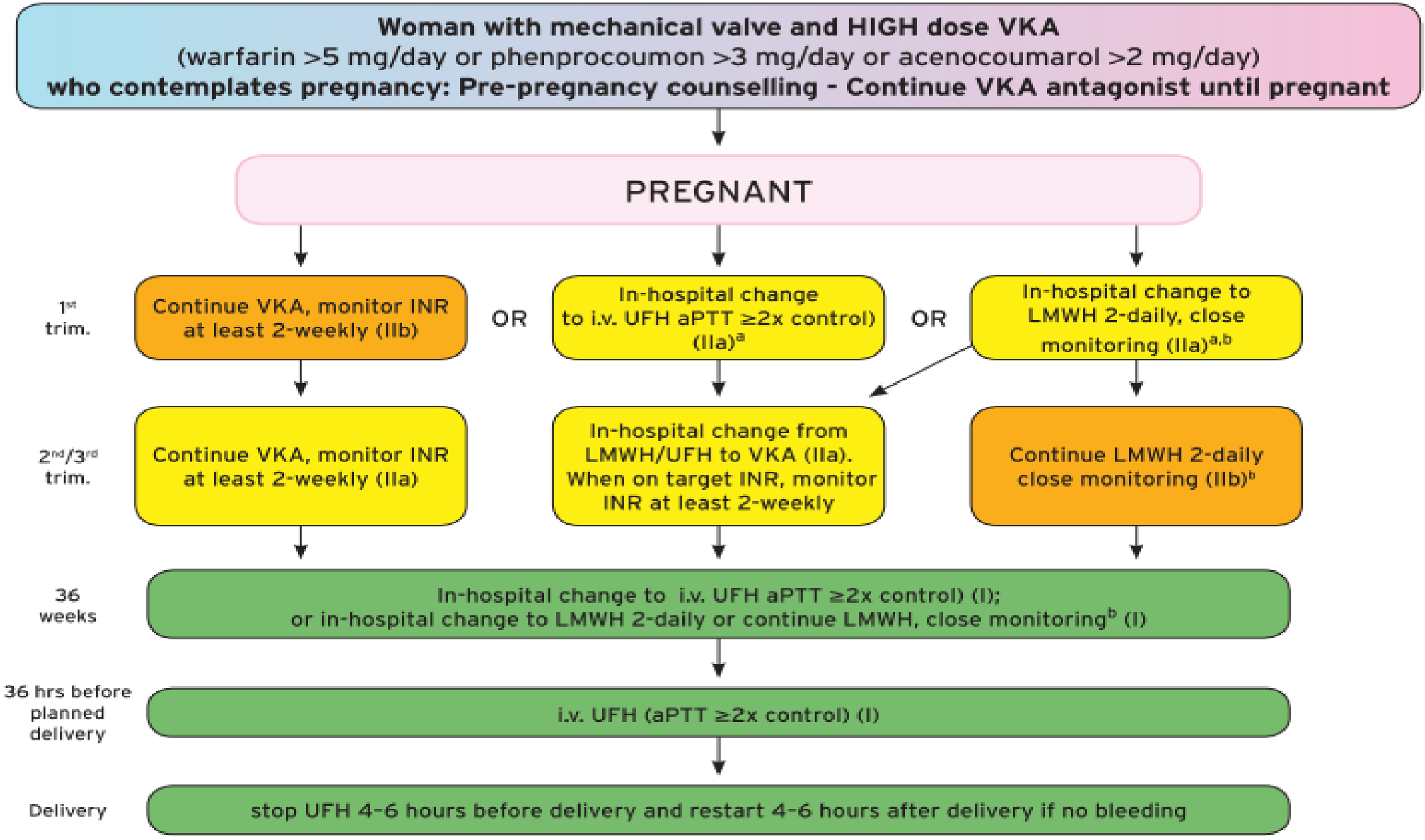
Initial Management of Prosthetic Heart Valves in Pregnant Women

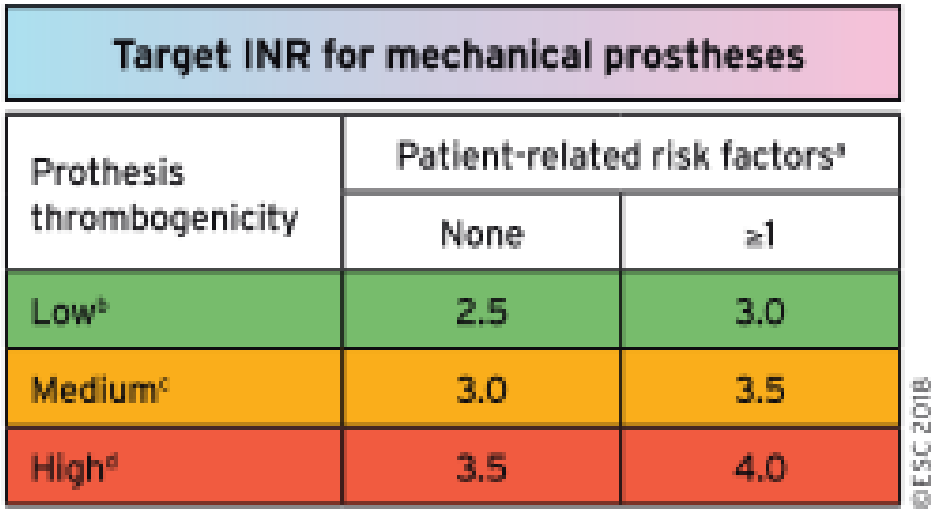
COR	LOE	Recommendations
1	C-EO	1. Women with a prosthetic valve should undergo pre-pregnancy assessment, including echocardiography, by a cardiologist with expertise in managing women with VHD during pregnancy.
1	C-EO	2. Pregnant women with a mechanical prosthesis should be monitored in a tertiary-care center with a dedicated MDT of cardiologists, surgeons, anesthesiologists, and maternal-fetal medicine obstetricians with expertise in the management of high-risk cardiac conditions during pregnancy.
1	B-NR	3. Women with mechanical heart valves considering pregnancy should be counselled that pregnancy is high risk and that there is no anticoagulation strategy that is consistently safe for the mother and baby.
1	B-NR	4. Pregnant women with a mechanical prosthetic valve who have prosthetic valve obstruction or experience an embolic event should undergo a TEE.

Anticoagulation for Pregnant Women With Mechanical Prosthetic Heart Valves

COR	LOE	Recommendations
1	B-NR	1. Pregnant women with mechanical prostheses should receive therapeutic anticoagulation with frequent monitoring during pregnancy.
1	B-NR	2. Women with mechanical heart valves who cannot maintain therapeutic anticoagulation with frequent monitoring should be counseled against pregnancy.
1	B-NR	3. Women with mechanical heart valves and their providers should use shared decision-making to choose an anticoagulation strategy for pregnancy. Women should be informed that VKA during pregnancy is associated with the lowest likelihood of maternal complications but the highest likelihood of miscarriage, fetal death, and congenital abnormalities, particularly if taken during the first trimester and if the warfarin dose exceeds 5 mg/d.


Woman with mechanical valve and LOW dose VKA
(warfarin <5 mg/day or phenprocoumon <3 mg/day or acenocoumarol <2 mg/day)
who contemplates pregnancy: Pre-pregnancy counselling - Continue VKA antagonist until pregnant
PREGNANT
1st trim.
Continue VKA, monitor INR at least 2-weekly (IIa)
OR
In-hospital change to LMWH 2-daily, close monitoring (IIb)a,b
OR
In-hospital change to i.v. UFH aPTT ≥2x control) (IIb)a
2nd/3rd trim.
Continue VKA, monitor INR at least 2-weekly (I)
In-hospital change from LMWH to VKA (I). When on target INR, monitor INR at least 2-weekly
In-hospital change from UFH to VKA (I). When on target INR monitor INR at least 2-weekly
36 weeks
In-hospital (change to) i.v. UFH aPTT ≥2x control) (I)
or in-hospital change to LMWH 2-daily, close monitoring[b] (I)
36 hrs before planned delivery
i.v. UFH (aPTT ≥2xcontrol) (I)
Delivery
stop UFH 4-6 hours before delivery and restart 4-6 hours after delivery if no bleeding


Woman with mechanical valve and HIGH dose VKA
(warfarin >5 mg/day or phenprocoumon >3 mg/day or acenocoumarol >2 mg/day)
who contemplates pregnancy: Pre-pregnancy counselling - Continue VKA antagonist until pregnant
PREGNANT
1st trim.
Continue VKA, monitor INR at least 2-weekly (IIb)
OR
In-hospital change to i.v. UFH aPTT ≥2x control) (IIa)a
OR
In-hospital change to LMWH 2-daily, close monitoring (IIa)a,b
2nd/3rd trim.
Continue VKA, monitor INR at least 2-weekly (IIa)
In-hospital change from LMWH/UFH to VKA (IIa). When on target INR, monitor INR at least 2-weekly
Continue LMWH 2-daily close monitoring (IIb)b
36 weeks
In-hospital change to i.v. UFH aPTT ≥2x control) (I);
or in-hospital change to LMWH 2-daily or continue LMWH, close monitoring[b] (I)
36 hrs before planned delivery
i.v. UFH (aPTT ≥2x control) (I)
Delivery
stop UFH 4-6 hours before delivery and restart 4-6 hours after delivery if no bleeding



Target INR for mechanical prostheses

Prothesis thrombogenicity	Patient-related risk factors[a]	
	None	≥1
Low[b]	2.5	3.0
Medium[c]	3.0	3.5
High[d]	3.5	4.0

Figure 4 Flowchart on anticoagulation in mechanical valves and target international normalized ratio for mechanical prostheses (modified from Baumgartner *et al.*[2014]). INR = international normalized ratio; LVEF = left ventricular ejection fraction. [a]Mitral or tricuspid valve replacement, previous thrombo-embolism, atrial fibrillation, mitral stenosis of any degree, or LVEF <35%. [b]Carbomedics, Medtronic Hall, ATS, or Medtronic Open-Pivot, St Jude Medical, On-X, or Sorin Bicarbon. [c]Other bileaflet valves with insufficient data. [d]Lillehei-Kaster, Omniscience, Starr-Edwards (ball-cage), Björk-Shiley and other tilting-disc valves; any pulmonary valve prosthesis.

Recommendations for the management of prosthetic heart valves

Recommendations	Class[a]	Level[b]
It is recommended that the valve prosthesis for a woman contemplating pregnancy is chosen in consultation with a pregnancy heart team.	I	C
It is recommended to manage pregnancy in women with mechanical valves in a centre with a pregnancy heart team.	I	C
If delivery starts while on a VKA or in less than 2 weeks after discontinuation of a VKA, caesarean section is recommended.	I	C
It is recommended to discontinue VKAs and start adjusted-dose intravenous UFH (aPTT ≥2x control) or adjusted-dose LMWH[c] (see separate recommendations) at the 36th week of gestation.	I	C
In pregnant women on LMWH or UFH, it is recommended to perform weekly anti-Xa level monitoring or aPTT monitoring with dose adjustment (within 36 h).	I	C
In pregnant women on a VKA, it is recommended to perform INR monitoring weekly or every 2 weeks.	I	C
In pregnant women with LMWH, it is recommended to target anti-Xa levels 4–6 h post-dose at 0.8–1.2 U/l (aortic valve prosthesis) or 1.0–1.2 IU/mL (mitral and right-sided valve prostheses).	I	C
It is recommended to replace LMWH with intravenous UFH (aPTT ≥2x control) at least 36 h before planned delivery. UFH should be continued until 4–6 h before planned delivery and restarted 4–6 h after delivery if there are no bleeding complications.	I	C
It is recommended to anticipate the timing of delivery to ensure safe and effective peripartum anticoagulation.	I	C
Immediate echocardiography is recommended in women with mechanical valves presenting with dyspnoea and/or an embolic event.	I	C
It is recommended to implement changes in the anticoagulation regimen during pregnancy in hospital.	I	C
During the second and third trimesters until the 36th week, VKAs are recommended in women needing a low dose.[d]	I	C

A bioprostheses should be considered in young women contemplating pregnancy.	IIa	C
During the second and third trimesters until the 36th week, VKAs should be considered in women needing a high dose.[e]	IIa	C
Continuation of VKAs should be considered during the first trimester if the warfarin dose required for therapeutic anticoagulation is <5 mg/day (or phenprocoumon <3 mg/day or acenocoumarol <2 mg/day) after patient information and consent.	IIa	C
Discontinuation of VKAs between weeks 6 and 12, and replacement with adjusted-dose intravenous UFH (aPTT ≥2x control) or adjusted-dose LMWH[c] twice daily (see separate recommendations), should be considered in patients with a warfarin dose >5 mg/day (or phenprocoumon >3 mg/day or acenocoumarol >2 mg/day).	IIa	C
During the second and third trimesters, LMWH[c] with anti-Xa level monitoring and dose adjustment (see separate recommendations) may be considered in women who need a high dose of VKA[e] after patient information and consent.	IIb	C
In pregnant women with LMWH, in addition to monitoring peak anti-Xa levels, monitoring pre-dose levels targeted at ≥0.6 IU/mL may be considered.	IIb	C
LMWH is not recommended when weekly anti-Xa level monitoring and dose-adjustment is not available.	III	C

aPTT = activated partial thromboplastin time; INR = international normalized ratio; LMWH = low molecular weight heparin; UFH = unfractionated heparin; VKA = vitamin K antagonist.

[a]Class of recommendation.

[b]Level of evidence.

[c]The starting dose for LMWH is 1 mg/kg body weight for enoxaparin and 100 IU/kg for dalteparin, twice daily subcutaneously.

[d]Low-dose VKA: warfarin <5 mg/day (or phenprocoumon <3 mg/day or acenocoumarol <2 mg/day).

[e]High-dose VKA: warfarin >5 mg/day (or phenprocoumon >3 mg/day or acenocoumarol >2 mg/day).

Anticoagulation for Pregnant Women With Mechanical Prosthetic Heart Valves

COR	LOE	Recommendations
1	C-LD	4. Pregnant women with mechanical valve prostheses who are on warfarin should switch to twice-daily LMWH (with a target anti-Xa level of 0.8 U/mL to 1.2 U/mL at 4 to 6 hours after dose) or intravenous UFH (with an activated partial thromboplastin time [aPTT] 2 times control) at least 1 week before planned delivery.
1	C-LD	5. Pregnant women with mechanical valve prostheses who are on LMWH should switch to UFH (with an aPTT 2 times control) at least 36 hours before planned delivery.
1	C-LD	6. Pregnant women with valve prostheses should stop UFH at least 6 hours before planned vaginal delivery.
1	C-LD	7. If labor begins or urgent delivery is required in a woman therapeutically anticoagulated with a VKA, cesarean section should be performed after reversal of anticoagulation.

Anticoagulation for Pregnant Women With Mechanical Prosthetic Heart Valves

COR	LOE	Recommendations
2a	B-NR	8. For pregnant women with mechanical prostheses who require a dose of warfarin ≤5 mg/d to maintain a therapeutic INR, continuation of warfarin for all 3 trimesters is reasonable after full discussion with the patient about risks and benefits.
2a	B-NR	9. For pregnant women with mechanical prostheses who require >5 mg/d of warfarin to achieve a therapeutic INR, dose-adjusted LMWH (with a target anti-Xa level of 0.8 to 1.2 U/mL at 4 to 6 hours after dose) at least 2 times per day during the first trimester, followed by warfarin during the second and third trimesters, is reasonable.
2a	B-NR	10. For pregnant women with mechanical prostheses who require a dose of warfarin >5 mg/d to achieve a therapeutic INR, and for whom dose-adjusted LMWH is unavailable, dose-adjusted continuous intravenous UFH during the first trimester (with aPTT 2 times control), followed by warfarin for the second and third trimesters, is reasonable.

Anticoagulation for Pregnant Women With Mechanical Prosthetic Heart Valves

COR	LOE	Recommendations
2b	B-NR	14. For pregnant women with mechanical prostheses, aspirin 75 to 100 mg daily may be considered, in addition to anticoagulation.
3: Harm	B-NR	15. For pregnant women with mechanical prostheses, LMWH should not be administered unless anti-Xa levels are monitored 4 to 6 hours after administration and dose is adjusted according to levels.
3: Harm	B-R	16. For patients with mechanical valve prostheses, anticoagulation with the direct thrombin inhibitor, dabigatran, should not be administered.
3: Harm	C-EO	17. The use of anti-Xa direct oral anticoagulants with mechanical heart valves in pregnancy has not been assessed and is not recommended.

Diagnosis and management of valve thrombosis

Management of valve thrombosis is comparable with management in non-pregnant patients.

Fibrinolysis should be applied in critically ill patients when surgery is not immediately available, and it should be considered when the risk of surgery is high.

Because foetal loss is high (30%) with surgery, fibrinolysis may be considered instead of surgery in non-critically ill patients when anticoagulation fails.

Fibrinolysis is the therapy of choice in right-sided prosthetic valve thrombosis.

Anticoagulation for Pregnant Women With Mechanical Prosthetic Heart Valves

COR	LOE	Recommendations
2a	B-NR	11. For hemodynamically stable pregnant women with obstructive left-sided mechanical valve thrombosis, it is reasonable to manage with slow-infusion, low-dose fibrinolytic therapy.
2b	B-NR	12. For pregnant women with mechanical prostheses who require a warfarin dose >5 mg/d to achieve a therapeutic INR, dose-adjusted LMWH (with a target anti-Xa level of 0.8 to 1.2 U/mL at 4 to 6 hours after dose) at least 2 times per day for all 3 trimesters may be considered.
2b	B-NR	13. For pregnant women with mechanical prostheses who require a dose of warfarin ≤5 mg/d to maintain a therapeutic INR, dose-adjusted LMWH at least 2 times per day during the first trimester, followed by warfarin for the second and third trimesters, may be considered.

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