counseling & management of anticoagulation in cardiac disease during pregnancy should be multidisciplinary & involve cardiology, cardiothoracic surgery, maternal-fetal medicine, & anesthesiology specialists

**Bioprosthetic Heart Valves**

- TISSUE, BOVINE, OR PORCINE
- require 3-6 months of anticoagulation with vitamin K antagonist after placement, followed by lifelong low-dose aspirin monotherapy
- continue low-dose aspirin monotherapy without interruption before, during, & after pregnancy for individuals with a bioprosthetic heart valve to reduce the risk of valve thrombosis

**Mechanical Heart Valves**

- valve thrombosis occurs in approximately 5% of pregnancies
- perinatal complications include:
  - increased risk of thrombosis
  - perinatal loss
  - preterm delivery
  - cesarean delivery
  - hemorrhage
- continue therapeutic anticoagulation before, during, & after pregnancy for individuals with a mechanical heart valve

**Anticoagulants**

In a meta-analysis, the estimated average risk of maternal adverse outcome throughout pregnancy, for:

- warfarin was 5.0%
- dose-adjusted LMWH was 15.5%
- dose-adjusted LMWH in the 1st trimester followed by warfarin was 15.9%

**Subcutaneous Unfractionated Heparin (UFH)**

- not recommended in pregnancy
- The use of new oral anticoagulants is not recommended in pregnant patients with mechanical heart valves because of an excess of thromboembolic and bleeding events

**Low Molecular Weight Heparin (LMWH)**

- preferred over UFH due to better bioavailability, more predictable anticoagulation with decreased bleeding risk, & lower incidence of both osteoporosis & heparin-induced thrombocytopenia
- starting dose is 1mg/kg (actual body weight) subcutaneously every 12 hours, adjusted to achieve therapeutic anti-Xa levels
- anti-Xa levels should be checked after 3 doses have been administered, 4 hours after dosing
- compatible with breastfeeding

**Warfarin**

- lowest risk of valve thrombosis
- highest likelihood of congenital abnormalities with 1st trimester use and perinatal loss, particularly with doses >5mg/day
- warfarin embryopathy includes nasal hypoplasia, chondrodysplasia punctata, cardiac malformations, microcephaly, ophtalmic atrophy, blindness, deafness, & central nervous system abnormalities may be dose dependent
- rate in pregnancies exposed in 1st trimester 2-30%
- crosses the placenta, & results in anticoagulation of the fetus compatible with breastfeeding, & poses no risk to the infant
- **REVERSAL** prothrombin complex concentrates
- 1/3 small doses of vitamin K

**Composite of**

- maternal death
- valve failure
- thrombosis

**Counseling & management of anticoagulation in cardiac disease during pregnancy should be multidisciplinary & involve cardiology, cardiothoracic surgery, maternal-fetal medicine, & anesthesiology specialists**
Planned Pregnancy

1st trimester

Developing fetus is most vulnerable to warfarin around 6-12 weeks of gestation.

Suggest continuing warfarin in the 1st trimester after counseling in individuals requiring a warfarin dose \( \leq 5 \text{mg/day} \) to maintain a therapeutic INR, taking into account the risk of warfarin embryopathy but decreased risk of valve thrombosis.

Suggest using adjusted-dose LMWH as an alternative anticoagulant during the 1st trimester in pregnant people with mechanical heart valves receiving warfarin \( >5 \text{mg/day} \) or in those who decline warfarin, provided anti-Xa levels are monitored every 1-2 weeks.

Recommend titrating LMWH dosing based on both trough (\( >0.6 \text{U/mL} \)) & peak (\( 0.8-1.2 \text{U/mL} \) for aortic valves \( \leq 1-1.2 \text{U/mL} \) for mitral valves) anti-Xa levels, with more frequent anti-Xa evaluations when dosing is adjusted.

Recommend against subcutaneous UFH, direct thrombin inhibitors, or direct oral anti-Xa anticoagulants to achieve therapeutic anticoagulation in pregnant persons with a mechanical heart valve.

2nd & 3rd trimesters

Suggest using warfarin for anticoagulation, from 12 weeks until 36 weeks of gestation, particularly for patients at high risk of thrombosis (Box 1), with an INR target of 2.5 for those with mechanical aortic valves \( \leq 3.0 \) for mechanical mitral valves.

Recommend continuing low-dose aspirin when indicated in pregnant people with mechanical heart valves in conjunction with therapeutic anticoagulation.

For patients declining warfarin in the 2nd & 3rd trimesters

Suggest using adjusted-dose LMWH, provided anti-Xa levels are monitored every 1-2 weeks.

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**Box 1. Conditions at high risk for mechanical valve thrombosis.**

- Mechanical mitral valve
- Right-sided mechanical valves
- Coexistent atrial fibrillation
- Left ventricular dysfunction
- Previous prosthetic valve thromboembolic complication
- Older generation mechanical valve (eg, ball-in-cage)
- Some hypercoagulable conditions*

*In particular, personal or strong family history of thrombosis, antithrombin deficiency, and hozygosity or compound heterozygosity for the factor V Leiden and/or prothrombin gene mutations.
**Delivery Timing & Mode of Delivery**

For pregnant persons with a mechanical heart valve and no other complications, we recommend a planned delivery 37.0 to 38.0 weeks of gestation, taking into consideration relevant maternal & fetal factors to determine the optimal mode of delivery.

**For pregnant persons with a mechanical heart valve anticoagulated with warfarin during the 2nd & 3rd trimesters**

Recommend transitioning to dose-adjusted LMWH at 35 to 36 weeks of gestation (with planned delivery 37-38 weeks of gestation) provided anti-Xa levels are monitored weekly using both trough (>0.6 U/mL) and peak (0.8-1.2 U/mL for aortic valves & 1-1.2 U/mL for mitral valves) levels then transitioning these patients to bridging anticoagulation with IV UFH in an inpatient setting 36 to 48 hours before planned delivery.

**For pregnant persons with a mechanical heart valve anticoagulated with dose-adjusted LMWH in the 2nd & 3rd trimesters**

Recommend transitioning to IV UFH in an inpatient setting 36 to 48 hours before planned delivery.

**Labour & Delivery**

IV UFH is usually started 12 hours after discontinuation of LMWH at a dose of 18 units/kg/hour, without a loading dose.

**Suggest titrating IV UFH during labor & delivery to achieve an anti-Xa level of 0.7 to 1.0 U/mL and maintained at this level until 4 to 6 hours before delivery.**

<table>
<thead>
<tr>
<th>For patients with a mechanical heart valve</th>
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<tr>
<td><strong>requiring a cesarean delivery</strong></td>
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<tr>
<td>recommend stopping the UFH infusion 4 to 6 hours before the scheduled surgery &amp; administering neuraxial anesthesia after documentation of a normal aPTT value</td>
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</tbody>
</table>

**After Delivery**

recommend removing the indwelling neuraxial catheter 4 to 6 hours after stopping IV UFH documentation of a normal aPTT value

For patients with a mechanical heart valve who have been therapeutically anticoagulated with warfarin within the last 2 weeks & who require an urgent delivery, recommend proceeding with a cesarean delivery to avoid fetal complications related to therapeutic anticoagulation with warfarin.

**Recommend that in pregnant persons with a mechanical heart valve the decision for anticoagulant reversal should be made in conjunction with cardiology, hematology, & anesthesia expertise while considering the individualized maternal & fetal risks.**
Postpartum suggest that therapeutic doses of IV UFH may be started as early as 4 to 6 hours after delivery and at least 1 hour after removal of an epidural/spinal catheter. Suggest reinitiation of IV UFH after delivery with the concomitant transition back to warfarin in the inpatient setting for ongoing therapeutic anticoagulation.

Breastfeeding recommend warfarin for anticoagulation in all postpartum individuals with a mechanical heart valve given its superior anticoagulant properties in avoiding valve thrombosis & the safety of warfarin for the breastfed infant.

Contraception

For individuals no longer desiring fertility, we recommend permanent sterilization.

Mechanical Valve Thrombosis

Physical exam findings:
- Muffled mechanical heart valve sounds
- New onset murmurs
- Signs & symptoms of congestive heart failure (dyspnea, orthopnea, pulmonary congestion)
- Signs of peripheral embolic phenomena (including myocardial infarction & stroke)

For others, 1st-line options include:
- Levonorgestrel-containing intrauterine device
- Progestrone subcutaneous implants
- Intramuscular depot medroxyprogesterone acetate

Diagnosis confirmed with echocardiography.

Urgent treatment with: tissue plasminogen activator (tPA) or emergent surgery (tPA has a short half-life [5 minutes] & does not cross the placenta).

Atrial Fibrillation (AF)

For pregnant individuals requiring therapeutic anticoagulation to decrease the risk for thromboembolic complications related to AF, recommend adjusted-dose LMWH.

For postpartum individuals requiring therapeutic anticoagulation to decrease the risk for thromboembolic complications related to AF, recommend adjusted-dose LMWH or warfarin until 6 weeks postpartum.*

*Beyond 6 weeks postpartum, ongoing anticoagulation should be determined by a cardiologist.

Left Ventricular Systolic Dysfunction

For pregnant individuals with left ventricular systolic dysfunction & an ejection fraction <35%, recommend adjusted-dose LMWH.

For postpartum individuals with left ventricular systolic dysfunction & an ejection fraction <35%, recommend adjusted-dose LMWH or warfarin until 6 weeks postpartum.*

*Beyond 6 weeks postpartum, ongoing anticoagulation should be determined by a cardiologist.

Fontan Circulation

= Direct connection of the caval veins into the pulmonary arteries.

For pregnant individuals with Fontan circulation who have additional risk factors for thromboembolism, recommend adjusted-dose LMWH.

For postpartum individuals with Fontan circulation who have additional risk factors for thromboembolism, recommend adjusted-dose LMWH or warfarin until 6 weeks postpartum.*

For postpartum individuals with Fontan circulation without additional risk factors for thromboembolism, recommend propylactic doses of LMWH during the postpartum period for 6 weeks.

For pregnant individuals with Fontan circulation who have additional risk factors for thromboembolism, recommend adjusted-dose LMWH.