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Contraception and Reproductive Planning for Women With Cardiovascular Disease

JACC Focus Seminar 5/5

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ABSTRACT

The majority of reproductive-age women with cardiovascular disease are sexually active. Early and accurate counseling by the cardiovascular team regarding disease-specific contraceptive safety and effectiveness is imperative to preventing unplanned pregnancies in this high-risk group of patients. This document, the final of a 5-part series, provides evidence-based recommendations regarding contraceptive options for women with, or at high risk for, cardiovascular disease as well as recommendations regarding pregnancy termination for women at excessive cardiovascular mortality risk due to pregnancy. (J Am Coll Cardiol 2021;77:1823–34) © 2021 by the American College of Cardiology Foundation.

Previously in this 5-part review series of cardiovascular disease in pregnancy, we covered the approach to the cardio-obstetrics patient from risk stratification and delivery planning through postpartum care (Part 1), congenital and heritable disorders (Part 2), acquired cardiovascular diseases (Part 3), and diagnostics and therapeutics (Part 4). In Part 5 of this review series, we will review contraceptive and reproductive planning options for women with cardiovascular disease.

TIMING OF REPRODUCTIVE COUNSELING

For reproductive-age women with known cardiovascular disease, pregnancy planning or prevention is imperative to optimize the health of both the mother and fetus. Many women with cardiovascular disease are prescribed potentially teratogenic medications, and pregnancy can potentially contribute to significant morbidity and mortality among women with pre-existing cardiovascular disease (1,2). Pregnancy management ideally begins with pre-conception counseling and recommendations regarding contraceptive options long before a woman actually conceives. Unfortunately, only about one-half of women with congenital heart disease (CHD) of child-bearing potential ever recall discussing contraception with their cardiologist, and less than one-half receive counseling before their first sexual encounter (2–5). Despite rising rates of acquired CVD in women of

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ABBREVIATIONS AND ACRONYMS

CHC = combined hormonal contraceptive

CHD = congenial heart disease

DMPA = depot medroxyprogesterone acetate

IUD = intrauterine device

LARC = long-acting reversible contraception

MEC = medical eligibility criteria

reproductive age, the frequency of reproductive discussions with cardiologists and this patient group is unknown. Up to 13% of female adolescents have engaged in sexual activity by age 15, and 68% of females have had sex at least once by age 17 (6). Study of patients with CHD identified that 26% of all adolescents (age 15 to 18 years) and 74% of all young adults (age 19 to 25 years) with CHD report ever having sex (7). Unfortunately, although the majority of young adults with cardiovascular disease are sexually active, and many of them may be prescribed potentially teratogenic medications including warfarin or angiotensin-converting enzyme inhibitors, contraception provision is rarely documented in their clinical record (8).

Previous studies have found that women with CHD, including those at high risk for cardiovascular complications of pregnancy, are also at increased risk of unplanned pregnancy (2,3,9). Despite this, few women with CHD are prescribed highly effective contraceptive methods. One study found that the majority of women with CHD who had an unplanned pregnancy were using methods with low or moderate effectiveness or no method at all at the time of conception (2,10). Given the prevalence of sexual activity among adolescents and young adults with CHD and the significant risk of unplanned pregnancy in this population, contraceptive and pregnancy counseling should begin in adolescence in pediatric cardiology clinics and continue through adulthood in adult cardiology clinics (5,11–14). Unfortunately, it is well known that a significant lapse in care is common at the time of transition from pediatric to adult cardiology clinics, and pregnancy is the primary reason for return to care for 12% of patients (15–18). Thus, early and ongoing discussion of sexual activity, contraceptive counseling, and pregnancy planning should be a routine part of the cardiovascular care plan for both women with CHD and those with acquired cardiovascular conditions.

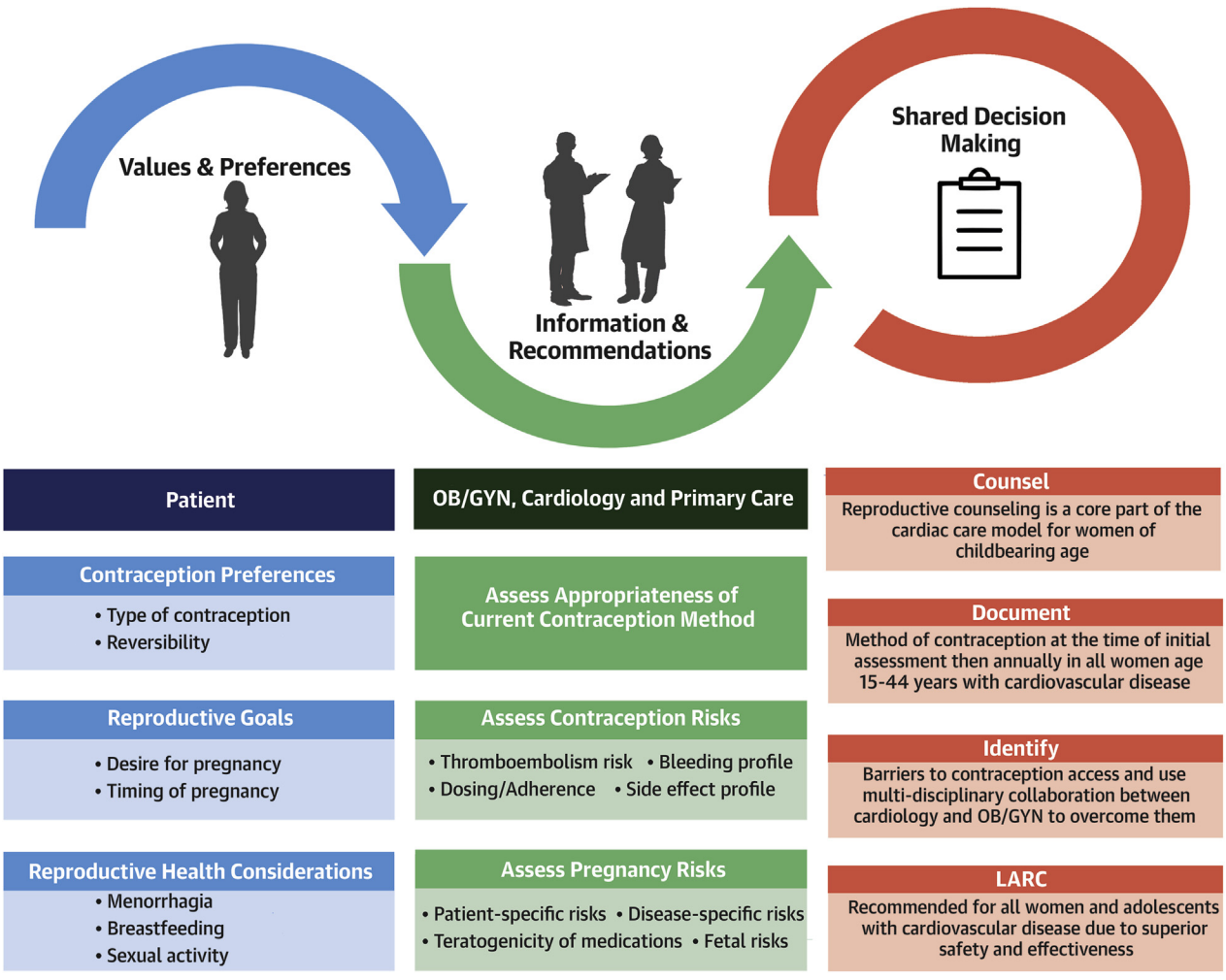
Recent data suggest that the majority of women with CHD also do not receive the recommended preconception evaluation (19). Given that only 24% of all U.S. women meet recommended metrics on reproductive counseling, many women with acquired CVD likely also do not receive recommended preconception counseling (20). Women with cardiovascular disease should be encouraged to develop reproductive goals in concert with their obstetrician, cardiologist and primary care provider (21). Shared decision-making should be used to devise goals and an action plan based on personal health and values that include deciding whether and when to attempt to become pregnant (21). Cardiovascular clinicians must be able to educate women with cardiovascular disease about how their condition(s) impact contraceptive and medical decision-making related to pregnancy. Ideally multidisciplinary team-based counseling and contraceptive management should be developed for women at increased risk of cardiovascular or fetal complications of pregnancy or with adverse gynecological sequelae of their cardiovascular disease, such as heavy menstrual bleeding due to anticoagulation (**Central Illustration**).

It is important for cardiovascular clinicians to assess for the need for contraception and appropriateness of contraceptive method both at the time of initial assessment and at subsequent annual encounters in all reproductive age women (age 15 to 44 years) with cardiovascular disease. If a patient identified to be at increased risk for pregnancy complications is also noted to be using a contraceptive method with low effectiveness, a discussion of reproductive goals and safe and effective methods of contraception is recommended. If the patient desires highly effective contraception, prompt referral should be made to an obstetrician/gynecologist comfortable with the provision of contraception for medically complex patients, with multidisciplinary collaborative efforts made for rapid scheduling given the gravity of unintended pregnancy in high-risk patients.

HIGHLIGHTS

- For women with known cardiovascular disease, pre-conception counseling and pregnancy planning are necessary to optimize the health of both mother and baby.
- Choosing a method of contraception for women with heart disease requires consideration of safety, effectiveness, patient preference and the risk of unplanned pregnancy in the context of the patient's specific cardiovascular condition.
- Because of their effectiveness and low risk of complications, intrauterine devices and subdermal implants should generally be recommended for appropriate candidates, including adolescent and nulliparous women.

CENTRAL ILLUSTRATION **Multidisciplinary Model for Shared Decision-Making in Contraception and Pregnancy Counseling for Women With Cardiovascular Conditions**



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Multidisciplinary shared decision-making including obstetrician/gynecologist, cardiology primary care provider, and the patient should consider the patient's goals, preferences, and values in addition to their individual and disease-specific risks of contraceptive methods and pregnancy when determining the optimal method of contraception. The cardiologist has an important responsibility to counsel reproductive-age women on pregnancy and contraception, document contraceptive needs, identify and help overcome barriers to contraception access, and advocate for highly effective and safe contraception. LARC = long-acting reversible contraception.

DISPARITIES IN CONTRACEPTION AND UNINTENDED PREGNANCY

Significant disparities exist regarding access to contraception and risk of unintended pregnancy. Notably, these populations share significant overlap with at-risk groups of women with high cardiovascular disease burden. The highest risk of unintended pregnancy is seen in women living below the poverty line, women with less than a high-school education, Black and Hispanic women, women age <24 years, and those who are cohabitating (20,22). Although racial/ethnic disparities in unintended pregnancy have declined over time, unfortunately they continue to persist (22). Geographically, the most rural and most urban parts of the country also report the highest rates of teenage births, infant mortality, and severe maternal morbidity (23–25).

Although many factors likely contribute to these statistics, women are less likely to have access to

contraceptive care if they are Black, Hispanic, of a lower socioeconomic status or education level, or uninsured (26). Major barriers to contraceptive care include: cost and lack of insurance, limited access to providers, clinical access issues (clinic hours, locations difficult to reach, and work and childcare responsibilities), limited transportation, or facilities that are not youth friendly (20,27,28). Over 19 million women in the United States, particularly in the South, Midwest, and Mountain West, live in "contraception deserts," and lack access to a facility in their county that is capable of providing a full range of contraceptive methods (29). Given the significant barriers to and the importance of obtaining safe and effective contraception, ensuring contraceptive access is an important part of providing comprehensive cardiovascular care.

APPROACH TO CONTRACEPTIVE COUNSELING

Shared decision-making is essential when providing contraceptive counseling to patients, such that autonomy and patient preference can drive the decision-making (30). It is often an iterative process, and more implementation studies are needed to best define how to integrate contraceptive counseling into routine clinical practice (31). When offering contraceptive options to a woman with cardiovascular disease, the risks and benefits of specific contraceptive methods must be weighed against the risks of unplanned pregnancy in the setting of the individual patient's specific cardiovascular condition (1). Consideration must be given to both the *generalized* risks of the contraceptive method, as well as the patient's *individual* risk of developing serious morbidity or mortality from the contraceptive method (32–34). The safety of contraceptives in a variety of cardiovascular conditions, based on the Centers for Disease Control U.S. Medical Eligibility Criteria (MEC) for Contraceptive use is summarized in **Table 1**.

CONTRACEPTIVE METHODS

Contraceptive methods can be divided into 3 tiers of effectiveness based on their typical-use failure rates (**Figure 1**) (35,36). Tier I methods, including permanent sterilization and long-acting reversible contraceptives (LARC) (intrauterine devices [IUDs] and implants), have typical-use 1-year failure rates of <1% (35,36). Tier II methods, including combined hormonal contraceptives (CHCs), progestin-only pills, and the depot medroxyprogesterone acetate (DMPA) injection, have typical-use failure rates of 6% to 12%/year. Tier III methods, including barrier methods, withdrawal, and natural family planning, have typical-use 1-year failure rates of 18% to 28% (36). Sexually active women using no method of contraception have an 85% risk of becoming pregnant within 1 year (36). Because of the superior safety and effectiveness of LARCs, the American College of Obstetricians and Gynecologists and the American Academy of Pediatrics recommend use in all appropriate candidates, including adolescents and nulliparous women (12,35,36). Given their excellent safety and efficacy profile, they should be recommended for women with underlying cardiovascular disease, particularly those at increased risk of cardiovascular complications of pregnancy (World Health Organization [WHO] class III to IV) or fetal risks due to teratogenic medication use or heritable disorders (11). Barrier methods are recommended in addition to tier I or II methods for prevention of sexually transmitted infections (36). A summary of the risks and benefits of the available methods of contraception is provided in **Table 2**.

TIER I METHODS. There are currently 4 levonorgestrel-releasing IUDs and 1 copper IUD available in the United States. All can be placed in the outpatient setting and are MEC 1 or 2 for women with cardiovascular disease (11,36). The hormonal IUDs are approved by the U.S. Food and Drug Administration for 3 to 6 years of use, depending on the brand, and the copper IUD is approved for 10 years (37,38). Typical-use 1-year failure rates of the hormonal IUD are 0.2% to 0.9%, and typical-use 1-year failure rate of the copper IUD is 0.8%. The risk of uterine perforation with insertion is 1 in 1,000, and transient cramping and vaginal bleeding is commonly experienced but is self-limited (39). The copper IUD is frequently associated with increased menstrual bleeding, which may make it unsuitable for women on antiplatelet or anticoagulant agents (11). However, the hormonal IUDs are associated with decreased menstrual bleeding; amenorrhea is reported in up to 20% of 52-mg levonorgestrel-IUD users by 1 year of use, which can be advantageous for women receiving these medications (11).

Previously there was concern about the potential for endocarditis with IUD insertion, however, the risk of endocarditis with placement of implanted devices appears to be exceptionally low and ACC/AHA guidelines do not recommend antibiotic prophylaxis for genitourinary procedures (11,40). There is a small risk of a vasovagal response during IUD placement, which may be poorly tolerated in patients with certain cardiovascular conditions such as single-

TABLE 1 Safety of Contraceptive Initiation and Continuation by Cardiovascular Condition

Condition	Subcondition	Cu IUD		LNG IUD		Implant		DMPA		POP		CHC	
		I	C	I	C	I	C	I	C	I	C	I	C
DVT/PE	History of DVT/PE, not on anticoagulation												
	High risk for recurrence	1		2		2		2		2		4	
	Low risk for recurrence	1		2		2		2		2		3	
	Acute DVT/PE	2		2		2		2		2		4	
	DVT/PE and on anticoagulation for at least 3 months												
	High risk for recurrence	2		2		2		2		2		4	
	Low risk for recurrence	2		2		2		2		2		4	
	Family history	1		1		1		1		1		2	
	Major surgery												
	With prolonged immobilization	1		2		2		2		2		4	
	Without prolonged immobilization	1		1		1		1		1		2	
	Minor surgery without immobilization	1		1		1		1		1		1	
Hypertension	Adequately controlled	1		1		1		2		1		3	
	Elevated blood pressure												
	Systolic 140–159 mm Hg or diastolic 90–99 mm Hg	1		1		1		2		1		3	
	Systolic ≥160 mm Hg or diastolic ≥100 mm Hg	1		2		2		3		2		4	
	Vascular disease	1		2		2		3		2		4	
Ischemic heart disease	Current and history of	1		2	3	2	3	3		2		3	4
Known thrombogenic mutations		1		2		2		2		2		4	
Multiple risk factors for ASCVD	(e.g., older age, smoking, diabetes, HTN, dyslipidemia)	1		2		2		3		2		3/4	
Obesity		1		1		1		1		1		2	
Peripartum cardiomyopathy	Normal or mildly impaired ventricular function												
	<6 months	2		2		1		1		1		4	
	≥6 months	2		2		1		1		1		3	
	Moderately or severely impaired ventricular function	2		2		2		2		2		4	
Smoking	Age <35 yrs	1		1		1		1		1		2	
	Age ≥35 yrs, <15 cigarettes/day	1		1		1		1		1		3	
	Age ≥35 yrs, >15 cigarettes/day	1		1		1		1		1		4	
Solid organ transplantation	Complicated (graft failure (acute or chronic), rejection, or cardiac allograft vasculopathy)	3	2	3	2	2		2		2		4	
	Uncomplicated	2		2		2		2		2		2	
Stroke	History of stroke	1		2		2	3	3		2		3	4
Valvular heart disease	Uncomplicated	1		1		1		1		1		2	
	Complicated (including pulmonary HTN, atrial fibrillation, and endocarditis)	1		1		1		1		1		4	

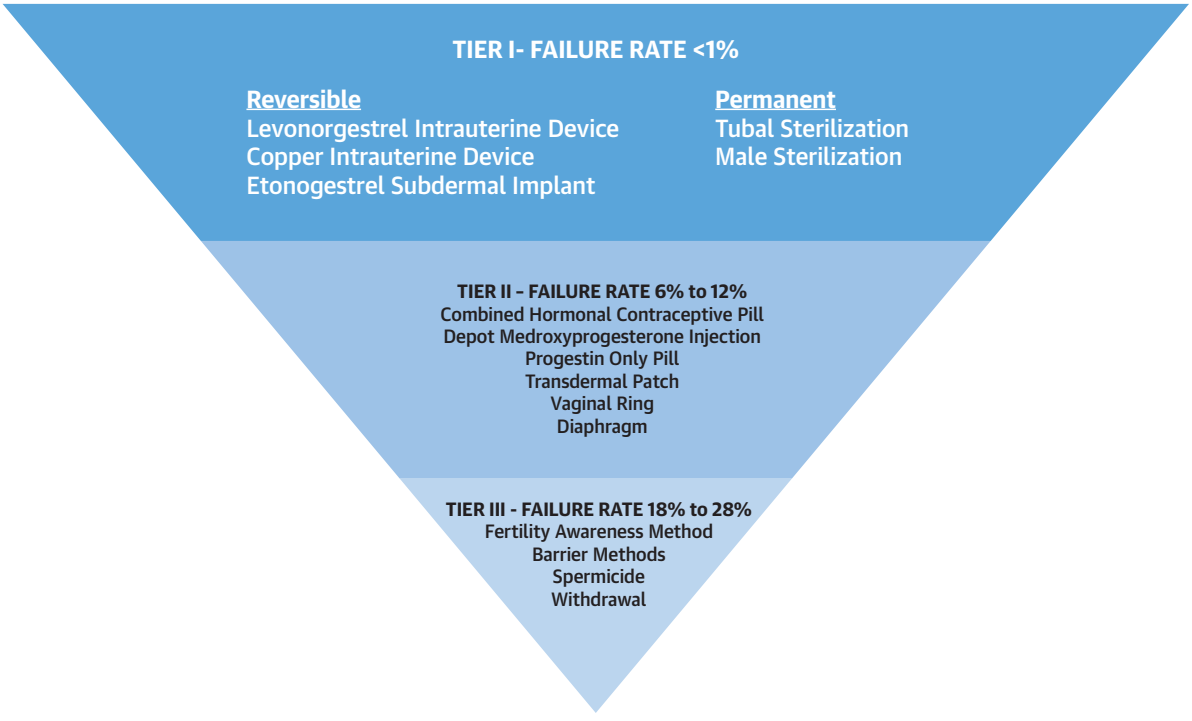
Adapted with permission from Curtis et al. (61). Categories: 1 = no restriction for use; 2 = benefits generally outweigh potential risks; 3 = risks generally outweigh benefit; and 4 = risk is unacceptable. C = continuation; CHC = combined hormonal contraceptive; Cu = copper; DMPA = depot medroxyprogesterone acetate; I = initiation; IUD = intrauterine device; LNG = levonorgestrel; POP = progestin only pills.

ventricle palliation or severe pulmonary hypertension. However, this risk is substantially outweighed by the benefits of highly effective contraception. We recommend patient education and empowerment to promptly report any symptoms concerning for impending vasovagal syncope, and clinician awareness and preparation to promptly treat a vasovagal response.

The subdermal implant is a small etonogestrel-releasing rod that is placed in the upper arm as an outpatient procedure (36,38). It is approved by the U.S. Food and Drug Administration for 3 years of use, and has a typical-use 1-year failure rate of 0.05% (36). It is considered MEC 1 or 2 for women with cardiovascular disease (36). For many women, the implant decreases the frequency and amount of menstrual bleeding, and 22% of women experience amenorrhea. However, irregular bleeding is a common side effect (41).

Permanent sterilization via tubal ligation or removal provides irreversible contraception for women who do not desire future fertility, with a 10-year failure rate of 2% (42). This may be performed at the time of delivery via postpartum tubal ligation following cesarean or vaginal delivery with minimal increased risk under regional anesthesia (43). This is a safe, cost-effective option for women who do not desire future pregnancies, but requires advanced planning. Postpartum sterilization is performed after 10% of all hospital deliveries, but requires prenatal

FIGURE 1 1-Year Failure Rates of Contraceptive Methods



Effectiveness of contraceptive methods is based on their typical-use 1-year failure rates. The Tier I methods—long-acting reversible methods (IUD and implant) and permanent sterilization—are safe and most effective for women with cardiovascular conditions. Tier II methods have lower effectiveness and increased safety concerns in the estrogen-containing methods (combined hormonal pill, transdermal patch, vaginal ring). The Tier III methods have the lowest effectiveness and are not recommended for use in isolation for women at increased risk of cardiovascular complications of pregnancy.

counseling and signed consent at least 30 days prior to procedure for women with Medicaid insurance (43). Women must be at least 21 years of age to be eligible for the procedure under Medicaid funds, but many clinicians are hesitant to provide the service to women under 30 years of age due to the risk of regret (43). However, 80% of women under 30 years of age do not regret their decision; the risk of regret may be decreased by adequate pre-procedure counseling (43,44). For women who undergo an interval tubal ligation (outside of the delivery hospitalization), it is typically performed under general anesthesia as a laparoscopic procedure and is generally an acceptable method of contraception for all women as long as they can tolerate general anesthesia and laparoscopy (11,45). Male sterilization has a 0.15% failure rate and is safe and effective for all women with cardiovascular disease in monogamous relationships (11,36).

TIER II METHODS. Overall, the most commonly prescribed forms of contraception in the United States are CHC methods, which include oral, transdermal, and transvaginal modes of delivery (the "pill," the "patch," and the "ring") (1). Each of these carries a typical-use 1-year failure rate of 9% (36). In general, most safety concerns are related to the increased risk of thromboembolism associated with the estrogen-containing methods (11,46). Although current preparations pose lower risk of thromboembolism than previous (no longer available) high-dose estrogen preparations, there is no reliable evidence that the thromboembolic risk differs among the pill, patch, and ring and the different pill formulations with varying doses of ethinyl estradiol currently available in the United States (46,47). Importantly, although the CHC methods do pose an increased risk of thromboembolism to the patient, the risk remains substantially lower than the thromboembolic risk of pregnancy (46). The risk of thromboembolism is increased among CHC users with comorbidities of tobacco use, age >35 years, hypertension, or hereditary thrombophilias (**Table 3**) (46,47).

CHC methods of contraception are not recommended in women at increased risk of significant morbidity or mortality related to thromboembolism.

TABLE 2 Risks, Advantages, and Side Effects of Commonly Used Methods of Contraception

Method	Risks	Side Effects	Advantages	Special Populations to Consider
Tier I				
Hormonal IUD	1/1,000 risk uterine perforation; vasovagal response at insertion	Amenorrhea, irregular bleeding and spotting, cramping	Lighter menses, possible amenorrhea, highly effective, safe for all cardiac conditions, no increased risk of thromboembolism	Excellent choice for women with menorrhagia due to anticoagulant or antiplatelet therapy
Copper IUD	1/1,000 risk uterine perforation; vasovagal response at insertion	Increased amount and duration of menstrual bleeding, cramping	Highly effective, safe for all cardiac conditions, effective as emergency contraception, no increased risk of thromboembolism	Poor choice for women with menorrhagia due to antiplatelet or anticoagulant therapy
Subdermal implant	Deep insertion could require surgical removal	Irregular bleeding and spotting	Highly effective, safe for all cardiac conditions, no increased risk of thromboembolism	May not be ideal for women with menorrhagia due to antiplatelet or anticoagulant therapy
Tubal sterilization	Requires anesthesia; typically performed laparoscopically—may not be well-tolerated by preload dependent patients	Not reversible	Highly effective, no effect on bleeding pattern	Women who do not desire future fertility; can be performed at the time of cesarean or vaginal delivery with minimal increased risk
Male sterilization	Requires monogamy	None	Highly effective, no risk to female cardiac patient	Women in established relationships who do not desire future fertility
Tier II				
Combined hormonal pill	Increased risk of thromboembolism	Irregular bleeding	More predictable and lighter bleeding, decreased menstrual cramping	Women at low risk for thromboembolism who can reliably take a daily medication
Transdermal patch	Increased risk of thromboembolism	Irregular bleeding, reaction to adhesive	More predictable and lighter bleeding, decreased menstrual cramping	Women at low risk for thromboembolism
Vaginal ring	Increased risk of thromboembolism	Irregular bleeding	More predictable and lighter bleeding, decreased menstrual cramping	Women at low risk for thromboembolism
Progestin-only pill	Low-dose pill requires strict adherence	Irregular bleeding	No increased risk of thromboembolism, may cause lighter bleeding or amenorrhea, decreased menstrual cramping	Highly reliable patients who are breastfeeding or at increased risk of thromboembolism
DMPA	Some studies suggest increased risk of thromboembolism	Irregular bleeding, weight gain, reversible bone loss, delayed return to fertility	Lighter menses or amenorrhea, decreased menstrual cramping	Patients with menorrhagia due to antiplatelet or anticoagulant therapy who do not find hormonal IUD to be an acceptable method
Diaphragm	Requires correct use with every act of intercourse	Increased risk of urinary tract infection, allergic reaction, rare risk of toxic shock syndrome	No effect on hormones or breastfeeding	Women in monogamous relationships
Tier III				
Barrier methods	Lower effectiveness, requires use at every act of intercourse	None	Only method that offers protection against sexually transmitted infections	Recommended in addition to tier I or II methods to prevent sexually transmitted infections

DMPA = depot medroxyprogesterone acetate; IUD = intrauterine device.

Although this risk should always be individualized to each unique patient's needs, there are several broad categories of cardiovascular conditions that are thought to pose an increased thromboembolic risk in the setting of CHC use (**Table 4**) (1,11,36). This includes certain congenital heart conditions (single ventricle palliation, cyanosis, and intracardiac or intrapulmonary shunting), valvular heart conditions (mechanical valves, atrial enlargement), cardiomyopathies (severe ventricular dysfunction or peripartum cardiomyopathy), vascular disorders (pulmonary hypertension, systemic hypertension, coronary arteritis, or ischemic heart disease), thromboembolic disease (prior thromboembolism or known thrombogenic mutations), and arrhythmias (atrial fibrillation/flutter, intra-atrial reentrant tachycardia), among others. Progestin-only methods including the hormonal IUD, the subdermal implant and progestin-only pills are not associated with increased risk of thromboembolism and are considered safe in these patient groups (11,36,47,48).

The DMPA injection is a high-dose progestin-only method that may be considered in women at increased risk for thromboembolic events, although some data suggests there may be an increased risk of thromboembolism with this method (48,49). DMPA has also been associated with weight gain, reversible bone loss, and delayed return to fertility (**Table 2**) (50,51). The typical-use 1-year failure rate of DMPA is 6%/year and requires repeat injections every 11 to 14 weeks (36). Although the progestin-only pill carries no significant increased risk of thrombosis, it has a 9%

TABLE 3 Recognized Risk Factors for Venous Thromboembolism in CHC Users

Tobacco use and age ≥35 yrs
<21 days after giving birth or 21 to 42 days after giving birth with other risk factors (e.g., age 35 years or older, previous venous thromboembolism, thrombophilia, immobility, transfusion at delivery, peripartum cardiomyopathy, body mass index ≥30 postpartum hemorrhage, post-Cesarean delivery, pre-eclampsia, or smoking)
Major surgery with prolonged immobilization
History of deep vein thrombosis or pulmonary embolism
Hereditary thrombophilia (including antiphospholipid syndrome)
Inflammatory bowel disease with active or extensive disease, surgery, immobilization, corticosteroid use, vitamin deficiencies, or fluid depletion
SLE with positive (or unknown) APL antibodies
Superficial venous thrombosis (acute or history)

APL = antiphospholipid; SLE = systemic lupus erythematosus.

typical-use 1-year failure rate and requires strict adherence to take the contraceptive at the same time every day (52).

CHC methods may be continued in healthy, nonsmoking women without cardiovascular risk factors up until the age of 50 to 55 years (47). CHC are MEC category 3 for women with hypertension and a blood pressure of 140 to 159/90 to 99 mm Hg. Although this is not an absolute contraindication, most obstetrician/gynecologist providers would avoid prescribing CHC, as estrogen can further elevate blood pressure. In select cases, CHC may be the most appropriate or acceptable method, in which case shared decision making should be used to discuss the risks and benefits (47). Uncontrolled hypertension with a blood pressure of ≥160/100 mm Hg or atherosclerotic vascular disease are an absolute contraindication to CHC (47). Women with type 1 or 2 diabetes mellitus do not have any specific contraindications to CHC use. However, if they have had disease duration >20 years, or evidence of microvascular disease, CHC are generally considered contraindicated (47). IUDs, implants, and progestin-only methods remain acceptable methods for all of these patient populations (36).

TIER III METHODS. Tier III methods include barrier methods (male condom, female condom, and sponge), spermicide, fertility awareness, and withdrawal (36). Although these methods do not carry any increased cardiovascular risk with use, they have lower effectiveness ranging between 18% and 28% typical-use failure rate per year (36). Given the high risk of unplanned pregnancy when used alone, they are not recommended for stand-alone use in women with high risk of serious morbidity or mortality related to pregnancy (1,11). Condoms are recommended in addition to tier I or II methods as they are the only method that provide protection against sexually transmitted infections (1).

EMERGENCY CONTRACEPTION

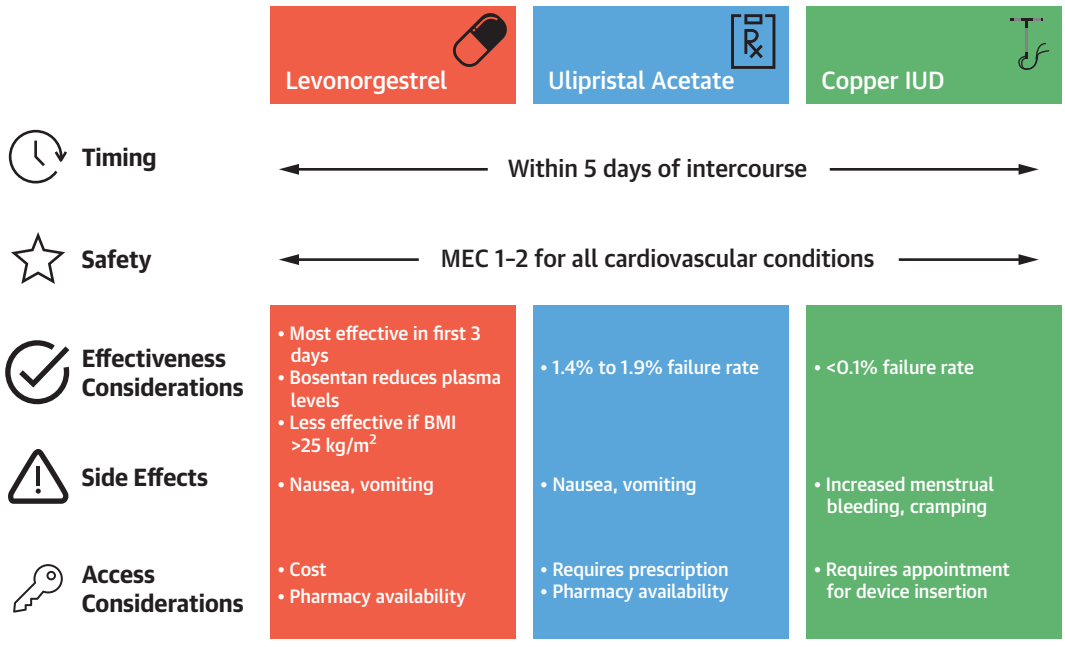
Several methods of post-coital or "emergency" contraception are available; oral levonorgestrel, oral ulipristal acetate, and insertion of copper IUD (**Figure 2**) (36). The emergency oral contraceptive pills must be administered within 5 days of unprotected intercourse, but are most effective if taken within 3 days (36,53). Ulipristal acetate is administered as a single 30-mg dose, whereas levonorgestrel can be administered as either a single 1.5-mg dose or a split dose of 0.75 mg 12 h apart (36). Failure rates are 2.2% for levonorgestrel and 1.4% to 1.9% for ulipristal (54–57). Ulipristal acetate is more effective in women taking emergency contraception between 3 and 5 days after intercourse or with body mass index >25 kg/m^2 (53,55). Given the short duration of action and the relative risk compared with pregnancy itself,

TABLE 4 Specific Cardiac Conditions in Which the Elevated Thromboembolic Risks Associated With Combined Hormonal Contraceptive Use Are of Concern

Congenital Heart Disease	Valvular Heart Disease	Vascular Disease	Cardiomyopathy	Thromboembolic Disease	Arrhythmias
Fontan circulation	Mechanical bileaflet valve	Pulmonary arterial hypertension	Dilated cardiomyopathy (LVEF <30%)	Prior thromboembolism	Atrial arrhythmias (atrial fibrillation/flutter, intra-atrial re-entrant tachycardia)
Cyanosis	Mechanical valve—Bjork-Shiley, Starr-Edwards, any mechanical valve in the tricuspid position	Previous coronary arteritis	Peripartum cardiomyopathy	Known thrombogenic mutations	
Potentially reversible L to R shunt (i.e., unoperated ASD)	Dilated left atrium	Ischemic heart disease			
Pulmonary AVM		Hypertension			

ASD = atrial septal defect; AVM = arteriovenous malformation; LVEF = left ventricular ejection fraction.

FIGURE 2 Key Features of Emergency Contraception



Three forms of emergency contraception are currently available and are considered safe for all cardiovascular conditions. They must be administered within 5 days of intercourse to be effective. Barriers to access reduce their uptake, and advanced provision of emergency contraception may be considered. MEC = Medical Eligibility Criteria.

emergency contraceptive pills are considered acceptable for use for all forms of cardiovascular disease (11,36). It is important to note that for women with pulmonary hypertension, bosentan may reduce levonorgestrel plasma levels and reduce the effectiveness of this method (54).

Patients should be counseled that the most common side effects associated with emergency contraception pills are nausea (13% to 23%) and vomiting (5.6%), which typically subside within 24 h of administration (36,54). Pre-treatment with antiemetics may be considered depending on availability and clinical judgement (36). If vomiting occurs within 3 h of administration, another dose should be taken as soon as possible, with an antiemetic if possible (36). Logistical and financial barriers to access can disproportionately impact low-income and rural women (54,58). Not all pharmacies carry emergency contraception, in particular ulipristal acetate (54). Pharmacies are less likely to carry emergency contraception if they are in low-income neighborhoods (54). Oral levonorgestrel is available over the counter to people of all ages since 2013. However, ulipristal acetate requires a prescription to obtain (58). Over-the-counter emergency contraception costs a median of $50, whereas per the Affordable Care Act, emergency contraception is covered by insurance when prescribed (54). Advanced provision of emergency contraception does increase the likelihood of use of emergency contraceptive pills (36).

Copper IUD insertion must occur within 5 days of the first act of unprotected intercourse to provide effective emergency contraception, or if the day of ovulation can be estimated it may occur within 5 days of ovulation (36). The failure rate of the copper IUD for emergency contraception is <0.1% (54). Although a copper IUD requires obtaining an appointment and procedure for placement, it has the advantage of providing up to 10 years of highly effective contraception after insertion (36). There is sparse data regarding the use of hormonal IUD insertion for emergency contraception limiting current recommendations for its use in this manner.

PREGNANCY TERMINATION

When women with severe cardiovascular disease become pregnant, or when women develop de novo cardiovascular disease during pregnancy, difficult decisions can arise. Women with cyanotic congenital

TABLE 5 Options for Pregnancy Termination in Women With Cardiovascular Disease

Subtype	Notes
Medical termination	
First trimester: mifepristone and misoprostol (in the United States); misoprostol alone or with methotrexate in countries where mifepristone is not available	Almost never preferred in women with cardiovascular disease, due to the unpredictable time course
	Avoid in women at high risk of bleeding complications
Second trimester: mifepristone and misoprostol or misoprostol alone	Avoid in women receiving anticoagulants
Surgical termination	
First trimester: uterine aspiration	Preferred in women at risk for cardiac complications or at increased risk for bleeding complication due to controlled, intraoperative environment
Second trimester: dilation and evacuation	

heart disease, advanced cardiomyopathy, or significant pulmonary arterial hypertension, for example, may be at particular risk for maternal and fetal mortality or major morbidity. Treating cardiologists have a primary obligation to treat the woman in the best way they can, to minimize fetal risks where possible, and to engage in honest and sometimes difficult shared decision-making. This may include recommending termination of pregnancy in circumstances where maternal risk is unacceptably high.

Unfortunately, the task of balancing maternal and fetal risk is made even more difficult by the absence of robust data to guide management of cardiovascular disease in pregnancy. Although pregnancy termination may be a challenging decision for some patients, women with WHO pregnancy class IV conditions should be offered termination due to the extremely high risk of maternal mortality or severe morbidity (1). Although pregnancy termination does carry some risk, abortion-related mortality is significantly lower than pregnancy-related mortality (59). Delays should be minimized for patients pursuing pregnancy termination, as the risk of an abortion-related complication increases along with gestational age (60).

Both medical and surgical methods of pregnancy termination are available (**Table 5**). Women with stable, well-controlled conditions such as diabetes or hypertension can safely undergo outpatient termination (59). Inpatient management of either medical or surgical abortion should be considered for women at highest risk of abortion-related cardiovascular events, including those with complex congenital heart disease, significant coronary artery disease, severe cardiomyopathy, significant valvular disease, or pulmonary arterial hypertension (59). Additional post-operative inpatient monitoring should be considered for women who are at increased risk of post-operative complications, including those having a later second trimester termination (particularly after 18 to 20 weeks gestation, due to increased physiological volume expansion of pregnancy), those with WHO class III to IV conditions for pregnancy, or those receiving anticoagulant or antiplatelet agents.

Although reversal of anticoagulation reduces periprocedural bleeding, it also increases risk of thromboembolism during this hypercoagulable period (59). The risk of major blood loss or transfusion does not appear to be significantly increased among women undergoing surgical termination on anticoagulation in the first trimester. Depending on the risk/benefit of the individual patient, continuation of anticoagulation during the peri-procedural period may be considered (59). Due to the potential for increased bleeding with pregnancy termination in the second trimester, consideration to holding anticoagulation should be given. Aspirin monotherapy does not significantly increase periprocedural bleeding (59). Although data is limited regarding bleeding risk of surgical termination in women receiving dual antiplatelet therapy, the individual risk/benefit ratio should be considered to determine whether discontinuation is warranted (59).

CONCLUSIONS

As described in this 5-part series, a cardio-obstetric team-based approach to the care of pregnant and lactating women is recommended. However, all clinicians, whether part of the cardio-obstetrics team or not, should be familiar with the safety, efficacy, and contraindications to contraceptive options for women with cardiovascular disease to adequately care for this population (**Table 2**). For sexually active women with cardiovascular disease, the use of highly effective contraception in a correct and consistent manner is the best way to reduce the risk of an unplanned pregnancy. LARCs, including IUDs and contraceptive implants, are most effective, followed by hormonal contraceptives. Condoms should also be encouraged to protect against sexually transmitted infections, although they are less effective for the prevention of pregnancy when used alone. When women at highest risk for mortality or severe morbidity (WHO class IV) become pregnant, pregnancy termination should be considered.

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