Contraception and Cardiovascular Disease

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Abbreviations

COC	Combined oral contraceptives
DMPA	Depot-medroxyprogesterone acetate
IUDs	Intrauterine devices
LARC	Long-acting reversible contraceptives
LNG-IUS	Levonorgestrel-releasing intrauterine system
PCOS	Polycystic ovary syndrome
PID	Pelvic inflammatory disease
WHO-MEC	WHO medical eligibility criteria

2.1   Introduction

With improvements in medical and surgical management, most women with congenital or acquired heart disease will reach reproductive age and become sexually active [1, 2]. As for healthy women, contraception is important for women with heart disease for various reasons. Besides preventing unintended pregnancies, it can be used for cycle control, treatment of hyperandrogenism and prevention of

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sexually transmittable diseases [3–5]. However, some issues, like drug interactions with cardiac medication and effects on haemodynamics, are very specific to women with cardiac disease and deserve particular attention.

Women with simple cardiac lesions often have similar pregnancy and contraceptive-related risks as healthy women, but these risks are substantially higher in women with complex heart disease [1, 2, 6]. Adequate contraception prevents unintended pregnancies and thereby the pregnancy associated risk of that particular cardiac condition. If pregnancy is undesired, contraception prevents termination of pregnancy, which, beside the emotional burden, also carries added medical risks in this population.

Contraception can also help to carefully plan and prepare women for pregnancy, which helps achieving better pregnancy outcomes. Some cardiac conditions imply an absolute contraindication for pregnancy, making effective contraception an essential part of disease management [2].

Most women with heart disease are not or, perhaps even worse, inappropriately advised on the use of contraceptives [7]. Oestrogen-containing formulations with their inherent increased risk of thromboembolic disease are still widely prescribed, while safer alternatives with better contraceptive efficacy are available [8, 9]. Each woman deserves personalised contraceptive advice, which takes her specific medical problems and personal preference into account. A team, consisting of general practitioners, cardiologists and gynaecologists, each with their particular area of expertise on the subject, is best paced to provide contraceptive advice to women with cardiac disease. In young girls with heart disease, it is important to address contraception from the menarche, which often starts around the age of 12–13; while this might seem early, up to 30 % will have sexual intercourse before the age of 15 and up to 50 % by the age of 17 [7, 8]. Usually, this event is not planned and without prior discussion with their parents or healthcare providers.

Most contraceptive advice is based on data from women without heart disease. The first consideration is the efficacy of the contraceptive method. Large studies have determined efficacy of each method, expressing efficacy as the incidence of unplanned pregnancy over a year of theoretical contraceptive use (correct use) or typical use (use in real live) as the main outcome measure [10]. The efficacy of a contraceptive method is based on its mechanism of action and is dependent on correct use. The discrepancy between theoretical and typical use is more pronounced when the method requires a substantial amount of compliance or in case of a smaller safety window (time frame in which contraceptive efficacy persists). Equally, the chances of the patient continuing to use a given contraceptive method are higher if she feels well while using that particular method [6]. Creating realistic expectations during counselling leads to higher satisfaction and helps accepting side effects that may be undesirable, as is the case with abnormal bleeding patterns [11–13]. These factors are important when striving for optimal patient adherence and long-term results.

The modified WHO classification of maternal cardiovascular risk assesses risks and consequences of pregnancy, and WHO medical eligibility criteria (WHO-MEC) for contraceptive use can be used as a guideline in women with specific conditions [14, 15]. Recommendations are made using four categories for each contraceptive

Table 2.1 MEC categories for contraceptive eligibility [15]

1	A condition for which there is no restriction for the use of the contraceptive method
2	A condition where the advantages of using the method generally outweigh the theoretical or proven risks
3	A condition where the theoretical or proven risks usually outweigh the advantages of using the method
4	A condition which represents an unacceptable health risk if the contraceptive method is used

method and medical condition including heart disease. Categories range from 1, where there is no restriction on the use of the contraceptive method, to category 4 where the condition represents an unacceptable health risk if the contraceptive method is used (Table 2.1) [15, 16]. These guidelines are regularly updated based on available evidence or on expert opinion if the evidence is lacking.

2.2 Short-Acting Contraceptives

Barrier contraceptives (male condoms, female condoms, diaphragms), coitus interruptus and fertility awareness-based methods (calendar methods, temperature curves) are considered insufficient as failure rates are substantial [10]. While 1 year of typical use of male condom as a sole form of contraception is associated with pregnancy rates up to 18 %, this method still has its value in protection against sexually transmitted diseases (STDs) or as an additional method of contraception when necessary.

Combined oestrogen and progesterone contraceptives are successful in preventing pregnancies, but their efficacy is highly dependent on correct use [10, 17].

They consist of different combinations and doses of either ethinylestradiol or estradiol along with a progestogen. The progestogen component varies and is classified by generation (1–4), each with specific characteristics. They are usually delivered in the form of a daily oral tablet but can also be administered transdermally (weekly patch) or through the vaginal mucosa (3-week vaginal ring), thereby avoiding the hepatic first-pass effect. This method acts on three different levels. Ovulation is inhibited; cervical mucus is thickened, preventing sperm penetration; and endometrial receptivity is altered, preventing implantation.

An advantage of the combined oral contraceptives (COC) is improved cycle control, with lighter, less painful and more regular periods. Traditionally, they are used for 3 weeks, after which a withdrawal bleed is induced, mimicking the natural cycle. However, the frequency of withdrawal bleeds can easily be reduced if desired by prolonged or continuous use [3, 4, 18]. Combined oral contraceptives can help in managing ovarian cysts, PCOS (polycystic ovary syndrome), or relieve symptoms of hyperandrogenism [5].

Of concern is the two- to sevenfold increased risk of venous thrombosis associated with any type of COC. This is mainly induced by the oestrogen component which elevates the level of circulating vitamin K-depending clotting factors,

plasminogen and platelet adhesion and reduces the anti-thrombin levels [16]. While this increase in risk is substantial and consequences are important, one should bear in mind that the absolute risk remains low in the range of 8–10/10,000 women-years exposure.

COC also increase the risk of arterial thrombosis and dyslipidaemia and may induce hypertension through an increase in the circulating blood volume [16, 19, 20].

Therefore, COC are not recommended or are contraindicated when the cardiac condition increases the risk of hypertensive, ischaemic or thrombogenic complications or when the consequences of such complications are more severe [9, 15]. As such, COC are not suitable in women with (a history of) ischaemic heart disease, hypertension and additional thrombogenic factors or women with atrial flutter or fibrillation [9, 21–23]. In women with potential right to left shunts (cyanotic heart disease, unoperated ASD), venous thrombosis might result in paradoxical embolism and stroke.

In women with complicated valvular disease or Fontan circulation, the risks and consequences of thrombogenic complications (mechanical valve thrombosis, pulmonary embolus) are such that this form of contraception is also contraindicated.

While some controversy exists on whether the increased thrombogenic risk of COC persists when anticoagulant drugs are used, most guidelines still recommend against the use of COC in these cases. An exception might be made in women on oral anticoagulants in whom ovulation bleeding leads to a massive life-threatening haemoperitoneum. In these rare cases, COC is the method of contraception that most effectively suppresses ovulation.

Also one should be aware of the potential influence of both progestogens and oestrogens on the metabolism of warfarin, requiring more frequent INR monitoring when COC are initiated in women on established oral anticoagulation therapy [24]. Alternatively, some drugs used in certain cardiac conditions may reduce the efficacy of combined oral contraceptives. Bosentan, which is used in management of pulmonary hypertension, accelerates the metabolism of contraceptive steroids, requiring additional contraceptive measures like a condom [9, 16, 25].

COC may induce some fluid retention, but there is no evidence that contraceptive steroid hormones affect cardiac function directly. Still, combined oral contraceptives are contraindicated in women with a reduced ejection fraction after a myocardial infarction, especially in the presence of other risk factors, like smoking and hypertension.

There is no formal contraindication for COC use in women with isolated arrhythmias (isolated supraventricular or ventricular extra beats, AVNT or VT in long QT syndrome).

Contraceptive pills, containing *progesterone only*, prevent sperm penetration by cervical mucus thickening and prevent implantation by reducing endometrial receptivity. If used in a higher dose, ovulation may be inhibited [17, 26]. No increased risk of thrombosis in women using progesterone-only pills is reported [27]. These pills can contain different types of progestogens with varying efficacy and safety window and are commonly used as additional contraception in lactating women.

Desogestrel (Cerazette)-containing tablets are effective in inhibiting ovulation with a safety window of 12 h and have similar efficacy as the combined oral contraceptive pill [9, 16, 25, 26, 28]. They are therefore the only pills of this type recommended in women with (severe) cardiac disease.

2.3   Long-Acting Reversible Contraceptives (LARC)

Long-acting reversible contraceptives consist of intrauterine devices (IUDs), sub-dermal implants and intramuscular injections of DMPA (depot-medroxyprogesterone acetate). By eliminating patient adherence, the efficacy of LARC is excellent, even exceeding sterilisation [10, 29]. Two models of IUDs exist: levonorgestrel-releasing intrauterine system (LNG-IUS) and copper-bearing IUDs. LNG-IUS induces endometrial atrophy and causes formation of a cervical mucus plug, impeding sperm penetration and implantation over a 5-year period. Copper is toxic to the ova and sperm and induces endometrial inflammation which prevents implantation, offering contraception for 10 years [30]. IUDs can be used in both nulliparous and multiparous women. IUDs can be inserted at any point of the cycle or directly postpartum [31, 32]. Insertion during menstruation offers immediate contraception and is facilitated by the physiological opening of the cervical ostium.

Fertility rapidly returns upon removal [29]. Uterine perforation and spontaneous expulsion are rare but are recognised complications. Importantly, IUDs are devoid of increased thrombotic risk. LNG-IUSs increase the levels of high-density lipoprotein, making it a good option for women with ischaemic heart disease and hyperlipidaemia [16, 20]. They often reduce menstrual blood loss, sometimes resulting in complete amenorrhea, but the bleeding pattern may become irregular in some women. It can help to control menstrual bleeding problems which occur more often in women using anticoagulants [33–35]. While the natural menstrual cycle is maintained with copper IUDs, an increase in blood loss and discomfort are often observed with menstruation.

The risk of pelvic infection is increased during the first 3 months after insertion, and transient bacteraemia has been documented at replacement but is rare in uncomplicated insertion or removal [36, 37]. Recent studies and guidelines do not recommend the standard use of prophylactic antibiotics to prevent either PID (pelvic inflammatory disease) or endocarditis at insertion [38–43]. Nevertheless, since the introduction of this guideline which limited the indications for antibiotic prophylaxis, an increase in prevalence of endocarditis has been observed in women with cardiac disease in general [44].

As such, the administration of prophylactic antibiotics (ampicillin 2 g and gentamicin 80 mg given intravenously 1 h before IUD insertion) may be considered in women at high risk of endocarditis [45]. Insertion of an IUD requires extra caution in women with pulmonary hypertension or Fontan repair. Vasovagal reactions may occur upon insertion due to pain and cervical manipulation, which is potentially dangerous in these women [9, 16, 21, 25, 46–48]. Insertion is therefore best

performed with pain relief (e.g. IV opioids), cardiovascular monitoring and anaesthetic support on standby, to prevent or adequately anticipate the consequences of a vagal reaction [48].

Subdermal implants, containing etonogestrel (Implanon) or levonorgestrel (Norplant), gradually release their progesterone over the course of 3 years, inhibiting ovulation and altering cervical mucus and endometrial receptivity. Subcutaneous insertion just below the medial groove between the biceps and triceps after local anaesthetic infiltration makes it a simple procedure, leading to contraception with an efficacy exceeding that of sterilisation [10]. Failure rates are low due to the elimination of the "patient adherence" factor. The newer easy-to-use insertion devices and incorporation of radioactive filaments prevent failure due to unnoticed loss and facilitate retrieval in the rare occasion of spontaneous migration of the device [29, 49]. The simplicity of insertion (no vasovagal reaction accompanying cervical manipulation), high efficacy and absence of increased thrombogenic risk make that subdermal implants are an excellent option for women with mechanical valves, pulmonary hypertension or Fontan repair [9, 11, 16, 21, 25, 29, 50, 51]. Women often experience a reduction in vaginal blood loss in terms of amount, frequency and duration of bleeding. Endometrial atrophy, which may occur after prolonged exposure to progesterone, may cause vascular fragility, occasionally leading to irregular and unpredictable bleeding or spotting [29, 52–55]. As previously mentioned, additional contraceptive measures should be taken in women using Bosentan.

Depot-medroxyprogesterone acetate offers reliable contraception if used every 13 weeks, with a grace period of 4 weeks, but effects usually last much longer. DMPA injections can induce intramuscular haematoma, but even in women on anticoagulants, this rarely seems to be of clinical significance [9, 16, 21, 25]. Uncertainty regarding a potential thrombogenic effect remains, as evidence is conflicting [27, 51, 56, 57].

2.4   Sterilisation

Sterilisation is a good option for patients with a contraindication for pregnancy or for couples with a completed family [9, 21, 25]. The role of sterilisation has decreased as other highly reliable and reversible contraceptive methods have emerged. Sterilisation does not offer non-contraceptive benefits like reduction of blood loss or cycle control.

Although sterilisation is considered a definitive method of contraception, reversal surgery may restore fertility in some cases. Laparoscopic tubal ligation and hysteroscopic insertion of intratubal stents are all considered good options, but these procedures carry risks. Laparoscopic *tubal ligation* is performed under general anaesthesia and requires a pneumoperitoneum with elevated intra-abdominal pressures and is therefore contraindicated in the presence of pulmonary hypertension or Fontan repair. Alternatively, an open or laparoscopic procedure with minimal inflation can be considered. Perioperative cessation of anticoagulation increases risk of

thrombosis, and anaesthesia and the procedure itself create an inherent risk of haemorrhage and infection [9, 21, 25, 58]. Sterilisation at the time of Caesarean section is associated with a slightly higher regret and failure rate as compared to a laparoscopic procedure [59, 60]. The psychological impact of definitive contraception, even in the case of severe heart disease with an absolute contraindication for pregnancy, should be taken into consideration. *Vasectomy* imposes no risk for the woman, but in case of a cardiac condition with a high chance of early demise, vasectomy may lead to male fertility problems in a future relationship.

Hysteroscopic tubal occlusion can also be achieved using various techniques. It does not require a skin incision or abdominal entry. Technical developments mean that hysteroscopes are now very thin and insertion devices allow these procedures to be performed with limited discomfort in an outpatient setting. However, pain relief (e.g. IV opioids), cardiovascular monitoring and anaesthetic support on standby remain necessary in women with pulmonary hypertension or Fontan repair, to prevent or adequately anticipate the consequences of a vagal reaction [48]. Currently, the most commonly used method consists of coils (Essure), which are inserted in the proximal part of the fallopian tube and induce fibrosis and occlusion. This method was approved in Europe and by the FDA and seems to have a low complication and low failure rate after tubal patency is assessed by ultrasound or hysterosalpingography after 3 months [61]. Nevertheless, recently some controversy on its safety emerged after the reports of numerous adverse events by women. This resulted in serious concerns about the risk of chronic pain, device migration and contraceptive efficacy [21, 25, 62–65]. Until these concerns are resolved, it is prudent to avoid this method.

2.5   Emergency Contraception

Emergency or postcoital contraception is essential in women not using any method or in whom a contraceptive method was not used appropriately (e.g. irregular pill intake, condom failure). The method with the highest contraceptive efficacy (failure rate of 0.09 %) is the insertion of a *copper IUD* within 120 h after intercourse.

A single dose of 1.5 mg *levonorgestrel* inhibits follicular growth or rupture and is therefore only effective before ovulation. It has a failure rate of 1.1 % if taken within 72 h after unprotected coitus. Obesity (BMI >30 kg/m^2) increases the failure rate, and a copper IUD should therefore be preferred in obese women requiring emergency contraception. Drug interactions with warfarin are reported, requiring close control of the INR [24].

Mifepristone 25 mg or *ulipristal acetate* 30 mg can be taken up to 120 h after unprotected intercourse. The superior efficacy of mifepristone and ulipristal over levonorgestrel may arise from ovulation inhibition and its additional postovulatory mechanism of action in inhibiting endometrial receptivity and tubal contractility. Proper counselling on reliable ongoing contraception should be offered at the time of provision of emergency contraception.

Conclusion

Contraceptive counselling in women with cardiovascular disease should begin early, preferably soon after menarche. Choices should be made by a multidisciplinary team, based on impact of pregnancy, safety of use, associated benefits of the contraceptive and the individual's preferences. Efficacy and ease of use are important factors for adequate contraception. Continuation rates are highest when the patient feels well using a particular method. Progestogen-only long-acting reversible contraceptive methods are a good option for patients with cardiovascular disease.

References

1. Baumgartner H, Bonhoeffer P, De Groot NM, de Haan F, Deanfield JE, Galie N et al (2010) ESC Guidelines for the management of grown-up congenital heart disease (new version 2010). Eur Heart J 31(23):2915–2957
2. Roos-Hesselink JW, Ruys TP, Stein JI, Thilen U, Webb GD, Niwa K et al (2013) Outcome of pregnancy in patients with structural or ischaemic heart disease: results of a registry of the European Society of Cardiology. Eur Heart J 34(9):657–665
3. Kaunitz AM (1999) Oral contraceptive health benefits: perception versus reality. Contraception 59(1 Suppl):29s–33s
4. Sulak PJ, Scow RD, Preece C, Riggs MW, Kuehl TJ (2000) Hormone withdrawal symptoms in oral contraceptive users. Obstet Gynecol 95(2):261–266
5. Dragoman MV (2014) The combined oral contraceptive pill – recent developments, risks and benefits. Best Pract Res Clin Obstet Gynaecol 28(6):825–834
6. Wellings K, Brima N, Sadler K, Copas AJ, McDaid L, Mercer CH et al (2015) Stopping and switching contraceptive methods: findings from Contessa, a prospective longitudinal study of women of reproductive age in England. Contraception 91(1):57–66
7. Rogers P, Mansour D, Mattinson A, O'Sullivan JJ (2007) A collaborative clinic between contraception and sexual health services and an adult congenital heart disease clinic. J Family Plan Reprod Health Care Fac Family Plan Reprod Health Care R Coll Obstet Gynaecol 33(1):17–21
8. Pijuan-Domenech A, Baro-Marine F, Rojas-Torrijos M, Dos-Subira L, Pedrosa-Del Moral V, Subirana-Domenech MT et al (2013) Usefulness of progesterone-only components for contraception in patients with congenital heart disease. Am J Cardiol 112(4):590–593
9. Thorne S, Nelson-Piercy C, MacGregor A, Gibbs S, Crowhurst J, Panay N et al (2006) Pregnancy and contraception in heart disease and pulmonary arterial hypertension. J Family Plan Reprod Health Care Fac Family Plan Reprod Health Care, R Coll Obstet Gynaecol 32(2):75–81
10. Trussell J (2011) Contraceptive failure in the United States. Contraception 83(5):397–404
11. Mansour D, Bahamondes L, Critchley H, Darney P, Fraser IS (2011) The management of unacceptable bleeding patterns in etonogestrel-releasing contraceptive implant users. Contraception 83(3):202–210
12. Mansour D, Korver T, Marintcheva-Petrova M, Fraser IS (2008) The effects of Implanon on menstrual bleeding patterns. Eur J Contracept Reprod Health Care Off J Eur Soc Contracept 13(Suppl 1):13–28
13. Modesto W, Bahamondes MV, Bahamondes L (2014) A randomized clinical trial of the effect of intensive versus non-intensive counselling on discontinuation rates due to bleeding disturbances of three long-acting reversible contraceptives. Hum Reprod 29(7):1393–1399
14. Regitz-Zagrosek V, Blomstrom Lundqvist C, Borghi C, Cifkova R, Ferreira R, Foidart JM et al (2011) ESC Guidelines on the management of cardiovascular diseases during pregnancy: the

Task Force on the Management of Cardiovascular Diseases during Pregnancy of the European Society of Cardiology (ESC). Eur Heart J 32(24):3147–3197

15. WHO Guidelines Approved by the Guidelines Review Committee. Medical eligibility criteria for contraceptive use (2015) World Health Organization, Geneva. Copyright (c) World Health Organization 2015

16. Mohan AR, Nelson-Piercy C (2014) Drugs and therapeutics, including contraception, for women with heart disease. Best Pract Res Clin Obstet Gynaecol 28(4):471–482

17. Milsom I, Korver T (2008) Ovulation incidence with oral contraceptives: a literature review. J Family Plan Reprod Health Care Fac Family Plan Reprod Health Care R Coll Obstet Gynaecol 34(4):237–246

18. Anderson FD (2006) Safety and efficacy of an extended-regimen oral contraception utilizing low-dose ethinyl estradiol. Contraception 74(4):355

19. Dong W, Colhoun HM, Poulter NR (1997) Blood pressure in women using oral contraceptives: results from the Health Survey for England 1994. J Hypertens 15(10):1063–1068

20. Lidegaard O, Lokkegaard E, Jensen A, Skovlund CW, Keiding N (2012) Thrombotic stroke and myocardial infarction with hormonal contraception. N Engl J Med 366(24): 2257–2266

21. Silversides CK, Sermer M, Siu SC (2009) Choosing the best contraceptive method for the adult with congenital heart disease. Curr Cardiol Rep 11(4):298–305

22. Camm AJ, Kirchhof P, Lip GY, Schotten U, Savelieva I, Ernst S et al (2010) Guidelines for the management of atrial fibrillation: the Task Force for the Management of Atrial Fibrillation of the European Society of Cardiology (ESC). Eur Heart J 31(19):2369–2429

23. Camm AJ, Lip GY, De Caterina R, Savelieva I, Atar D, Hohnloser SH et al (2012) 2012 focused update of the ESC Guidelines for the management of atrial fibrillation: an update of the 2010 ESC Guidelines for the management of atrial fibrillation. Developed with the special contribution of the European Heart Rhythm Association. Eur Heart J 33(21):2719–2747

24. Ellison J, Thomson AJ, Greer IA, Walker ID (2000) Drug points: apparent interaction between warfarin and levonorgestrel used for emergency contraception. BMJ (Clin Res Ed) 321(7273):1382

25. Thorne S, MacGregor A, Nelson-Piercy C (2006) Risks of contraception and pregnancy in heart disease. Heart 92(10):1520–1525

26. Korver T, Klipping C, Heger-Mahn D, Duijkers I, van Osta G, Dieben T (2005) Maintenance of ovulation inhibition with the 75-microg desogestrel-only contraceptive pill (Cerazette) after scheduled 12-h delays in tablet intake. Contraception 71(1):8–13

27. Mantha S, Karp R, Raghavan V, Terrin N, Bauer KA, Zwicker JI (2012) Assessing the risk of venous thromboembolic events in women taking progestin-only contraception: a meta-analysis. BMJ (Clin Res Ed) 345:e4944

28. Wald RM, Sermer M, Colman JM (2011) Pregnancy and contraception in young women with congenital heart disease: general considerations. Paediatr Child Health 16(4):e25–e29

29. Espey E, Ogburn T (2011) Long-acting reversible contraceptives: intrauterine devices and the contraceptive implant. Obstet Gynecol 117(3):705–719

30. Stephen Searle E (2014) The intrauterine device and the intrauterine system. Best Pract Res Clin Obstet Gynaecol 28(6):807–824

31. Bahamondes MV, Hidalgo MM, Bahamondes L, Monteiro I (2011) Ease of insertion and clinical performance of the levonorgestrel-releasing intrauterine system in nulligravidas. Contraception 84(5):e11–e16

32. Kapp N, Curtis KM (2009) Intrauterine device insertion during the postpartum period: a systematic review. Contraception 80(4):327–336

33. Vigl M, Kaemmerer M, Niggemeyer E, Nagdyman N, Seifert-Klauss V, Trigas V et al (2010) Sexuality and reproductive health in women with congenital heart disease. Am J Cardiol 105(4):538–541

34. Huq FY, Tvarkova K, Arafa A, Kadir RA (2011) Menstrual problems and contraception in women of reproductive age receiving oral anticoagulation. Contraception 84(2):128–132

35. Zingone MM, Guirguis AB, Airee A, Cobb D (2009) Probable drug interaction between warfarin and hormonal contraceptives. Ann Pharmacother 43(12):2096–2102
36. Murray S, Hickey JB, Houang E (1987) Significant bacteremia associated with replacement of intrauterine contraceptive device. Am J Obstet Gynecol 156(3):698–700
37. Everett ED, Reller LB, Droegemueller W, Greer BE (1976) Absence of bacteremia after insertion or removal of intrauterine devices. Obstet Gynecol 47(2):207–209
38. Nishimura RA, Carabello BA, Faxon DP, Freed MD, Lytle BW, O'Gara PT et al (2008) ACC/AHA 2008 Guideline update on valvular heart disease: focused update on infective endocarditis: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines endorsed by the Society of Cardiovascular Anesthesiologists, Society for Cardiovascular Angiography and Interventions, and Society of Thoracic Surgeons. J Am Coll Cardiol 52(8):676–685
39. Centre for Clinical Practice at N. National Institute for Health and Clinical Excellence: Guidance Prophylaxis against infective endocarditis: antimicrobial prophylaxis against infective endocarditis in adults and children undergoing interventional procedures (2008) National Institute for Health and Clinical Excellence (UK) National Institute for Health and Clinical Excellence, London
40. Grimes DA, Schulz KF (2001) Antibiotic prophylaxis for intrauterine contraceptive device insertion. Cochrane Database Syst Rev (2):Cd001327
41. Ladipo OA, Farr G, Otolorin E, Konje JC, Sturgen K, Cox P et al (1991) Prevention of IUD-related pelvic infection: the efficacy of prophylactic doxycycline at IUD insertion. Adv Contracept Off J Soc Adv Contracept 7(1):43–54
42. Sinei SK, Schulz KF, Lamptey PR, Grimes DA, Mati JK, Rosenthal SM et al (1990) Preventing IUCD-related pelvic infection: the efficacy of prophylactic doxycycline at insertion. Br J Obstet Gynaecol 97(5):412–419
43. Walsh TL, Bernstein GS, Grimes DA, Frezieres R, Bernstein L, Coulson AH (1994) Effect of prophylactic antibiotics on morbidity associated with IUD insertion: results of a pilot randomized controlled trial, IUD Study Group. Contraception 50(4):319–327
44. Dayer MJ, Jones S, Prendergast B, Baddour LM, Lockhart PB, Thornhill MH (2015) Incidence of infective endocarditis in England, 2000–13: a secular trend, interrupted time-series analysis. Lancet (Lond, Engl) 385(9974):1219–1228
45. Suri V, Aggarwal N, Kaur R, Chaudhary N, Ray P, Grover A (2008) Safety of intrauterine contraceptive device (copper T 200 B) in women with cardiac disease. Contraception 78(4):315–318
46. Gemzell-Danielsson K, Mansour D, Fiala C, Kaunitz AM, Bahamondes L (2013) Management of pain associated with the insertion of intrauterine contraceptives. Hum Reprod Update 19(4):419–427
47. Ott J, Promberger R, Kaufmann U, Huber JC, Frigo P (2009) Venous thrombembolism, thrombophilic defects, combined oral contraception and anticoagulation. Arch Gynecol Obstet 280(5):811–814
48. Roos-Hesselink JW, Cornette J, Sliwa K, Pieper PG, Veldtman GR, Johnson MR (2015) Contraception and cardiovascular disease. Eur Heart J 36(27):1728–1734, 34a-34b
49. Jacobstein R, Polis CB (2014) Progestin-only contraception: injectables and implants. Best Pract Res Clin Obstet Gynaecol 28(6):795–806
50. Aznar R, Reynoso L, Ley E, Gamez R, De Leon MD (1976) Electrocardiographic changes induced by insertion of an intrauterine device and other uterine manipulations. Fertil Steril 27(1):92–96
51. Lidegaard O, Nielsen LH, Skovlund CW, Skjeldestad FE, Lokkegaard E (2011) Risk of venous thromboembolism from use of oral contraceptives containing different progestogens and oestrogen doses: Danish cohort study, 2001–9. BMJ (Clin Res Ed) 343:d6423
52. Culwell KR, Curtis KM (2009) Use of contraceptive methods by women with current venous thrombosis on anticoagulant therapy: a systematic review. Contraception 80(4):337–345
53. Kadir RA, Chi C (2007) Levonorgestrel intrauterine system: bleeding disorders and anticoagulant therapy. Contraception 75(6 Suppl):S123–S129

54. Pisoni CN, Cuadrado MJ, Khamashta MA, Hunt BJ (2006) Treatment of menorrhagia associated with oral anticoagulation: efficacy and safety of the levonorgestrel releasing intrauterine device (Mirena coil). Lupus 15(12):877–880

55. Sordal T, Inki P, Draeby J, O'Flynn M, Schmelter T (2013) Management of initial bleeding or spotting after levonorgestrel-releasing intrauterine system placement: a randomized controlled trial. Obstet Gynecol 121(5):934–941

56. Lidegaard O, Nielsen LH, Skovlund CW, Lokkegaard E (2012) Venous thrombosis in users of non-oral hormonal contraception: follow-up study, Denmark 2001–10. BMJ (Clin Res Ed) 344:e2990

57. Goldstein J, Cushman M, Badger GJ, Johnson JV (2007) Effect of depomedroxyprogesterone acetate on coagulation parameter: a pilot study. Fertil Steril 87(6):1267–1270

58. Snabes MC, Poindexter AN 3rd (1991) Laparoscopic tubal sterilization under local anesthesia in women with cyanotic heart disease. Obstet Gynecol 78(3 Pt 1):437–440

59. Hillis SD, Marchbanks PA, Tylor LR, Peterson HB (1999) Poststerilization regret: findings from the United States Collaborative Review of Sterilization. Obstet Gynecol 93(6):889–895

60. Peterson HB, Xia Z, Hughes JM, Wilcox LS, Tylor LR, Trussell J (1996) The risk of pregnancy after tubal sterilization: findings from the U.S. Collaborative Review of Sterilization. Am J Obstet Gynecol 174(4):1161–1168; discussion 8–70

61. Adelman MR, Dassel MW, Sharp HT (2014) Management of complications encountered with Essure hysteroscopic sterilization: a systematic review. J Minim Invasive Gynecol 21(5): 733–743

62. Famuyide AO, Hopkins MR, El-Nashar SA, Creedon DJ, Vasdev GM, Driscoll DJ et al (2008) Hysteroscopic sterilization in women with severe cardiac disease: experience at a tertiary center. Mayo Clin Proc 83(4):431–438

63. Duffy S, Marsh F, Rogerson L, Hudson H, Cooper K, Jack S et al (2005) Female sterilisation: a cohort controlled comparative study of ESSURE versus laparoscopic sterilisation. BJOG 112(11):1522–1528

64. Kerin JF, Cooper JM, Price T, Herendael BJ, Cayuela-Font E, Cher D et al (2003) Hysteroscopic sterilization using a micro-insert device: results of a multicentre phase II study. Hum Reprod 18(6):1223–1230

65. Dhruva SS, Ross JS, Gariepy AM (2015) Revisiting essure – toward safe and effective sterilization. N Engl J Med 373(15), e17