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REVIEW

Contraception after pregnancy

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Abstract

Whatever the outcome, pregnancy provides the opportunity to offer effective contraception to couples motivated to avoid another pregnancy. This narrative review summarizes the evidence for health providers, drawing attention to current guidelines on which contraceptive methods can be used, and when they should be started after pregnancy, whatever its outcome. Fertility returns within 1 month of the end of pregnancy unless breastfeeding occurs. Breastfeeding, which itself suppresses fertility after childbirth, influences both when contraception should start and what methods can be used. Without breastfeeding, effective contraception should be started as soon as possible if another pregnancy is to be avoided. Interpregnancy intervals of at least 6 months after miscarriage and 1-2 years after childbirth have long been recommended by the World Health Organization in order to reduce the chance of adverse pregnancy outcome. Recent research suggests that this may not be necessary, at least for healthy women <35 years old. Most contraceptive methods can be used after pregnancy regardless of the outcome. Because of an increased risk of venous thromboembolism associated with estrogen-containing contraceptives, initiation of these methods should be delayed until 6 weeks after childbirth. More research is required to settle the questions over the use of combined hormonal contraception during breastfeeding, the use of injectable progestin-only contraceptives before 6 weeks after childbirth, and the use of both hormonal and intrauterine contraception after gestational trophoblastic disease. The potential impact on the risk of ectopic pregnancy of certain contraceptive methods often confuses healthcare providers. The challenges involved in providing effective, seamless service provision of contraception after pregnancy are numerous, even in industrialized countries. Nevertheless, the clear benefits demonstrate that it is worth the effort.

KEYWORDS
childbirth, contraception, ectopic, gestational trophoblastic disease, induced abortion, miscarriage, pregnancy

Abbreviations: CHC, combined hormonal contraception; DMPA, depo-medroxyprogesterone acetate; EP, ectopic pregnancy; GTD, gestational trophoblastic disease; IUC, intrauterine contraception; LARC, long-acting reversible contraception; LNG-IUS, levonorgestrel-releasing intrauterine system; MEC, Medical Eligibility Criteria for Contraceptive Use; POC, progestogen-only contraception; WHO, World Health Organization.

*The list of the Annual Capri Workshop Group contributors is given in the Appendix.

1 | INTRODUCTION

Contraception saves lives and pregnancy provides an opportunity to offer effective contraception to couples motivated to avoid another pregnancy who, in some countries, may have very limited contact with healthcare providers.

Not all pregnancies are intended: in 2012, an estimated 40% of all pregnancies worldwide were unintended.[1] In Scotland in 2004-05, 90% of pregnancies among women requesting abortion were clearly unintended; 26% of women attending an antenatal clinic were ambivalent about pregnancy intention, and 9% had definitely not intended pregnancy when they conceived.[2] An estimated 12% of miscarriages and ectopic pregnancies in the UK are unintended at conception.

All women should be offered effective contraception after pregnancy, whatever the outcome. Yet the opportunity is often missed. Data from 57 low- and middle-income countries demonstrated that 62% of women giving birth in the preceding year did not initiate contraception immediately postpartum.[3] Even in high-income countries, provision of effective contraception after delivery is often sub-optimal. Only around 50% of postpartum women in a Texan study expressing a preference for either long-acting reversible contraception (LARC) or sterilization received their preferred method.[4] About 70% of pregnancies occurring within 1 year postpartum in the USA are unintended.[5] In Scotland, over 13% of parous women presenting for induced abortion had been pregnant within the preceding year.[6] Repeat induced abortion is common worldwide even in countries with excellent contraceptive services. In the Netherlands for example, approximately 36% of all abortions are repeats.[7]

Health services everywhere are often fragmented; healthcare providers often work in silos; and healthcare providers managing pregnancy simply do not think about giving contraceptive advice, believing that someone else will take care of it. The UK NICE guideline on the management of miscarriage and ectopic pregnancy (EP), for example, does not mention asking about the intendedness of the pregnancy or the need for contraception.[8]

This paper reviews the evidence, and recommendations, for contraception after pregnancy ending in either childbirth, induced or spontaneous abortion, or ectopic or molar pregnancy. It highlights areas of controversy and, where indicated, makes suggestions for further research.

2 | MATERIAL AND METHODS

A small group of experts, chosen for their knowledge of the evidence and their familiarity with clinical practice in Europe, met to discuss the topic of contraception after childbirth. Eight of them prepared oral presentations summarizing the available evidence on which contraceptives could be used, and when they should be started, after pregnancy ending in childbirth, induced or spontaneous abortion, EP and gestational trophoblastic disease (GTD); and the barriers to their effective provision by healthcare services.

Key message

Postpartum contraception saves lives. Most women can use most methods of contraception after pregnancy. Because services work in silos, seamless provision of contraception after pregnancy, especially immediate postpartum provision of long-acting methods is challenging—even in industrialized countries. Nevertheless, the clear benefits demonstrate that it is worth the effort.

Individual presenters selected the most recent systematic reviews available, undertaking searches performed in Medline, Popline, EMBASE, and Cochrane library databases for relevant English-language publications from 1970 to mid-2018. If topics were not covered by systematic reviews, the same databases were used to search for the most recent primary research papers. Each presenter provided a written, referenced summary of their presentation, which was circulated some 4 weeks before the meeting of the Annual Capri Workshop in Reproductive Medicine (held in October 2018). Although not formally assessed for quality, the evidence presented was critically reviewed and discussed in detail by the workshop participants. Before the end of the meeting, the participants agreed an outline of the resulting narrative review presented here.

2.1 | Contraception after childbirth

After childbirth, Cleland et al[9] suggest that on a global scale contraception prevents some 30% of maternal deaths and 10% of infant deaths if pregnancies are spaced >2 years apart. Based on the observation that pregnancies within the first year postpartum have increased risks for fetal and early neonatal death, preterm birth, low birthweight, and small-for-gestational-age infants,[10] in 2007 the World Health Organization (WHO) recommended waiting at least 2 years after childbirth before attempting the next pregnancy. In a report published in 2013, WHO further advised that if women wait 2 years to conceive again, under-5 mortality decreases by 13%, and by 25% following 3 years delay.[11] However, a recent study using methodology adjusting for a woman's predisposition to have these adverse pregnancy outcomes questioned the causal link between interpregnancy intervals and adverse pregnancy outcomes.[12] In a study of women giving birth in Sweden, short interpregnancy intervals (0-3 months) were not causally associated with increased risk of stillbirth or early neonatal death.[13] A study from British Columbia confirmed the lack of association for women under 35 years but cautioned against short interpregnancy intervals for older women.[14] In low- and middle-income countries where maternal and perinatal mortality and morbidity are high and where women may often start, and end, a pregnancy undernourished and anemic, long interpregnancy intervals may be beneficial. In countries where women are commonly delaying first

childbirth until well into their 30s, where most are healthy, and antenatal care routine and paid parental leave are the norm, short interpregnancy intervals may well not be harmful should couples choose to start another pregnancy soon after childbirth.

2.2 | When should contraception start after childbirth?

During pregnancy, high circulating levels of estrogens and progesterone from the placenta suppress gonadotropin levels to 1% of nonpregnant values. Estrogen stimulates pituitary lactotrophs resulting in high concentrations of prolactin. Without lactation after delivery, concentrations of prolactin decline whereas those of luteinizing hormone and follicle-stimulating hormone increase over 30 days, leading to the restoration of menstrual cycles. In nonlactating women, the first menses after childbirth is often preceded by anovulation, but by the third menses, over 80% of women have normal ovulatory cycles. In a systematic review of the limited data, Jackson and Glasier[15] reported a mean time of first ovulation among nonlactating women between 45 and 94 days postpartum. In 20%-71% of women, first menses was preceded by ovulation and up to 60% of these ovulatory cycles were thought to be potentially fertile. Hence, women who do not breastfeed should be advised that without contraception pregnancy can occur within the first 2 months after childbirth. If a woman breastfeeds, prolactin concentrations remain elevated and gonadotropins are suppressed. The duration of suppressed ovarian activity depends on the breastfeeding pattern. Frequent suckling episodes, including at night, prolong ovarian suppression. The introduction of artificial milk and/or solid food coincides with a reduction in the frequency and duration of breastfeeding episodes and as the suppressive effect of suckling wanes so ovarian activity resumes. In a study of 27 breastfeeding mothers, first menses occurred at a mean of 32.5 weeks after childbirth, preceded by ovulation in 33%.[16] Breastfeeding influences not only when contraception should be started, but also which methods can be used. The formalized Lactational Amenorrhea Method advises that another method of contraception should be started when the baby reaches 6 months, or sooner if menses returns or exclusive/almost exclusive breastfeeding stops (and supplements are introduced). Two controlled studies of Lactational Amenorrhea Method users at 6 months postpartum reported life-table pregnancy rates of 0.45% and 2.4%, while 6 uncontrolled studies reported pregnancy rates from 0% to 7.5%.[17]

2.3 | Which methods can be used after childbirth?

2.3.1 | Hormonal contraception

The relative risk of venous thromboembolism is increased approximately 5-fold in pregnancy, and 60-fold in the puerperium, particularly during the first 3 weeks. The risk is theoretically increased by using combined hormonal contraception (CHC). Women are advised to wait at least 3 (and preferably 6) weeks before starting CHC.[18] Women with additional risk factors for venous thromboembolism must wait 6 weeks. Low-dose progestogen-only methods are not associated with any increased risk of venous thromboembolism and, although limited evidence suggests a possible small increased risk of thrombosis in association with use of DepoProvera, all methods are considered safe (Medical Eligibility Criteria for Contraceptive Use [MEC] category 1) for postpartum women.

WHO has concerns about the theoretical risk of CHC on breastfeeding continuation or exclusivity, and about old reports of possible effects on infant growth or health. It advises that CHC should not be used before 6 months postpartum by breastfeeding women, unless no other method is available or acceptable (WHO MEC, Category 3).[18] However, most trials published after 2005 do not report any significant impact of CHC on breastfeeding duration, breast milk composition, or infant growth,[19] and the UK[20] and US guidance[21] recommend that the benefits outweigh the theoretical risks of CHC use after 6 weeks postpartum (Category 2) among breastfeeding women.

Despite progestogen-only contraception (POC) having no apparent direct impact on breastfeeding, child health or development,[22] WHO still expresses theoretical concern about the potential exposure of the neonate to depo-medroxyprogesterone acetate (DMPA) and norethisterone enanthate and recommends delaying initiation of these injectable POC methods until after 6 weeks postpartum. The USA and UK do not recommend any such delay. Progestin-only pills and implants can be started immediately after childbirth regardless of infant feeding.

2.3.2 | Intrauterine contraception

Copper intrauterine devices and the levonorgestrel-releasing intrauterine system (LNG-IUS) can be inserted during cesarean section or within 48 h of vaginal delivery. WHO[18] does not recommend insertion between 48 hours and 4 weeks after childbirth because of higher rates of expulsion compared with later interval insertion; however, the US MEC[21] considers that the benefit of insertion at this time outweighs the risks. A recent systematic review and meta-analysis review reported expulsion rates of 1.9% for interval insertion, 10.0% for immediate post-placental insertion and almost 30% for insertion between 10 minutes and 4 weeks. Rates of expulsion were higher for the LNG-IUS than for copper devices inserted before 4 weeks (adjusted relative risk 1.91, 95% CI 1.50-2.43) and after vaginal delivery were 5 times higher than after insertion at the time of cesarean section.[23]

The risk of uterine perforation is increased throughout lactation and is highest up to 6 months after delivery for both copper intrauterine devices and LNG-IUS (6-fold increase, 7 per 1000 insertions,[24] underlining the importance of postpartum placement of intrauterine contraception (IUC) being performed by experienced healthcare providers. IUC insertion should be avoided in women with postpartum sepsis.

2.3.3 | Other methods

Condoms can be used as soon as needed. Diaphragm or cap fitting should wait until 6 weeks postpartum, when involution of the cervix

is complete. Fertility awareness-based methods can be used when the menstrual cycle has resumed. Oral emergency contraception, if required, should be offered from 21 days postpartum, but ulipristal acetate is not recommended in breastfeeding women. Regret and dissatisfaction may be more common following sterilization performed immediately postpartum and this should be done only after careful counseling.

2.4 | Contraception after miscarriage (spontaneous abortion)

Miscarriage is the commonest adverse pregnancy outcome with estimated rates of 8%-20%. In the UK, 10% to 15% of all pregnancies end in miscarriage and an estimated 12% of these result from unintended pregnancies.

2.5 | When should contraception start after miscarriage?

First menses occurs at a mean of 29 days after miscarriage, with ovulation preceding menses in all women.[25] Hence, if pregnancy is not desired, contraception should be started immediately. WHO recommends waiting at least 6 months before trying to conceive again. However, a recent study,[26] using Scottish national data, showed that women with an interpregnancy interval of <6 months were less likely to have another miscarriage (adjusted odds ratio 0.66, 95% CI 0.57-0.77), preterm delivery (0.89, 0.81-0.98), or infant of low birthweight (0.84, 0.71-0.89). A systematic review of 16 studies[27] reached similar conclusions. Current evidence suggests that, if pregnancy is desired, it is not necessary to use contraception after miscarriage, and couples wishing to conceive again should be advised to try as soon as they feel ready.

2.6 | What contraceptive methods can be used after miscarriage?

All methods of contraception can be used without any restriction after miscarriage, and the most effective method acceptable should be offered. The risk of expulsion of intrauterine methods may be higher when inserted after a second-trimester abortion (vs first trimester).[18] Diaphragms and caps should not be fitted before 6 weeks after second-trimester miscarriage to allow for complete involution of the cervix.

2.7 | Contraception after induced abortion

About 90% of women ovulate in the first month after first-trimester abortion and >50% resume sex within 2 weeks.[28] Contraception should therefore be started immediately regardless of gestation, unless sepsis is present, and all methods can be used.[18]

Repeat abortion is common. LARC methods have been repeatedly shown to reduce the risk of repeat unintended pregnancy after induced abortion.[29] IUC can be inserted at surgical abortion or following expulsion of the fetus at medical abortion and early insertion increases uptake after both medical and surgical abortion.[28,30] Increasing use of medical abortion and home administration of misoprostol as well as self-assessment of the outcome of the abortion complicate contraceptive provision, especially LARC. Fewer US women having medical abortion had an intrauterine device insertion compared with those undergoing surgical abortion.[31] Initiation of LARC is being explored at ever earlier intervals. There are theoretical concerns about a possible interaction between progestins and the anti-progesterone mifepristone used for medical abortion. Although insertion of a POC implant at the time of mifepristone administration does not impair the efficacy of early medical abortion,[32] administration of DMPA with mifepristone increased the risk of failed medical abortion (ongoing pregnancy) compared with DMPA administration delayed until after the abortion (3.5% vs 0.9%).[33] A recent study suggested that giving DMPA at the time of misoprostol administration had no effect on ongoing pregnancy rates.[34] A recent randomized controlled trial demonstrated an increased risk of partial expulsion with fast-track (≤3 days) insertion of the LNG-IUS compared with insertion 2-4 weeks after misoprostol administration (expulsion rates 12-28 vs. 2%-4%).[30,35] However, use of LNG-IUS was higher and pregnancy rates were lower at 1 year if the device had been inserted immediately.[36] As with IUC insertion immediately after childbirth, from a public health perspective the advantages of immediate IUC insertion after medical abortion (improved uptake and reduced repeat pregnancy rates) appear to outweigh the disadvantage of increased expulsion rates. The IUC can be replaced provided expulsion is recognized.

Besides the contraceptive methods being offered, how the service is being delivered is of importance. Provision of LARC by the same unit providing the abortion care decreased the risk of subsequent abortion.[29]

2.8 | Contraception after ectopic pregnancy

Ectopic implantation of the embryo occurs in 1%-2% of confirmed pregnancies and accounts for at least 6% of pregnancy-related deaths worldwide. With earlier diagnosis and improved treatment, modern management emphasizes preserving fertility. There is no evidence of a delay in return to fertility after EP.[37] Women who want to avoid another pregnancy should start effective contraception immediately. For women wishing to conceive, the chance of the next pregnancy being intrauterine is 60%-70% regardless of the mode of treatment,[37] but the recurrence rate of EP is 10%-15% after one EP and 30% after a second.[38]

All methods of contraception reduce the risk of pregnancy, and women who have had EP may use any method.[18] No contraceptive methods increase the risk of EP but some, depending on the mode of action, may do a better job of preventing it, a fact that confuses many providers. The absolute risk of EP during contraceptive use is very low. A recent systematic review of implants and injectable POC[39] concluded that these methods are highly effective at preventing any pregnancy, but that levonorgestrel-releasing implants (which inhibit ovulation inconsistently) have a higher rate of EP when they fail compared with etonogestrel-releasing implants or DMPA, both of which inhibit ovulation consistently. Low-dose oral

POCs, which inhibit ovulation inconsistently and alter tubal motility, significantly reduce the risk of EP compared with condoms or no method.[20] Failure of emergency contraception is not associated with an increased risk of EP. Although intrauterine contraceptives are the most effective reversible contraceptives, when pregnancy occurs with an intrauterine device or LNG-IUS in situ there is an increased risk of EP and assessment by ultrasound scan should be expedited. The cumulative probability of EP 10 years after female sterilization has been reported as 2.4 per 1000 procedures.[40]

If EP is managed with methotrexate, contraception should be used to avoid a theoretical risk of teratogenesis. Manufacturers recommend contraception for 6 months after methotrexate treatment stops, the UK Royal College of Obstetricians and Gynaecologists recommends 3 months.[20] Limited evidence suggests that conception within 3 months of methotrexate use is not associated with an increased risk of fetal malformation,[20] but pregnancies occurring before 6 months should nevertheless be carefully screened.

2.9 | Contraception after gestational trophoblastic disease (molar pregnancy)

The risk of malignant disease following surgical evacuation of a complete mole is 15%-20% and after incomplete or partial mole it is 0.5%-5%.[41] Serum human chorionic gonadotropin monitoring is pivotal to managing GTD, allowing early identification of malignancy and reliable follow up after chemotherapy. Conception during the monitoring phase raises human chorionic gonadotropin and considerably complicates the management, causing delayed diagnoses or misdiagnoses of malignancy. Women becoming pregnant within 6 months after diagnosis of molar pregnancy (or 12 months after chemotherapy for malignant disease) have an increased risk of morbidity and mortality.[41] For this reason, contraception is mandatory and should be started immediately because ovulation returns rapidly after uterine evacuation. Up to 12%-23% of women conceive before the scheduled end of the monitoring period, suggesting that the contraceptive method used should be highly effective. Initial studies of hormonal contraception in women with a recent diagnosis of GTD suggested an increased risk of developing malignancy. Trophoblastic cells have sex steroid receptors, the proliferative activity of which can be modulated by reproductive hormones. Recent epidemiological evidence is reassuring. A systematic review concluded a lack of causality between hormonal contraception and GTD[42] and 2 large case series not included in the review failed to demonstrate any detrimental effect of hormonal contraception.[43] To date, there is no evidence to contraindicate hormonal contraception during the clinical management of women with GTD. All hormonal contraceptives can be used without any restrictions after GTD, but, despite no evidence of any detrimental effect on disease outcome, intrauterine contraception is contraindicated until after human chorionic gonadotropin levels have returned to normal.[18] Among clinicians there appears to be a natural reluctance to insert a device into a uterus which may be more vulnerable to perforation and, perhaps, hemorrhage.

2.10 | Lessons for improving provision of contraception after pregnancy

The benefits of providing effective contraception after pregnancy are clear.

Fertility resumes rapidly after pregnancy regardless of outcome. If contraception is left until a follow-up appointment (which many women fail to attend)[28,44] many women are already at potential risk of pregnancy and those choosing LARC methods often face further delays accessing trained providers.

Educational interventions about contraceptive use after childbirth, including giving women advice antenatally, are generally of low quality. Limited evidence suggests that some educational interventions can increase uptake of contraception—including the most effective methods—after childbirth.[45,46] In Scotland, information given by midwives at an antenatal visit has been part of the pathway of a successful initiative to increase LARC uptake after delivery.[47]

Peri-abortion information-giving alone does not appear to influence uptake of LARC or risk of further unplanned pregnancy;[48] it should be part of a pathway to facilitate access to and initiation of contraception.

Visual and verbal information are acceptable to women after both childbirth and abortion.[49,50] The use of pre-prepared scripts saves time and ensures consistent information; DVDs and web-based information are becoming increasingly acceptable. Most women given information about the contraceptive implant using a DVD had knowledge recall as good as with a face-to-face consultation and found the DVD helpful and easy to understand.[51] Women find contraceptive counseling acceptable during the abortion consultation.[47] Telephone counseling about contraception, separated from the abortion consultation, is an alternative model.[52]

The "best" contraceptive method after pregnancy is the one that the informed individual woman considers most appropriate for her—and which she is therefore most likely to continue. Information should be provided about all suitable contraceptives and should include discussion about the comparative efficacy of all available methods. The least effective methods include male and female condoms (failure rate 18%-20% in the first year of use), spermicides (failure rate 28%) and fertility-awareness-based methods (failure rate 24%). Diaphragms have a moderate failure rate (12%/year) whereas hormonal methods that rely on correct and consistent use have failure rates of between 5% and 8% per year. LARC clearly provides the best protection against pregnancy with failure rate <1% per year and satisfaction with the most effective LARC methods can be high even for women whose initial preference is for a short-acting method.[53]

2.11 | Barriers to provision

Many barriers limit provision of contraception after pregnancy, some are more easily overcome than others. Lack of knowledge, appropriate training and the ability to prescribe among the cadre of staff who manage the outcome of the pregnancy whether childbirth, miscarriage or induced abortion, often deter them from taking responsibility for contraceptive provision. Lack of staff trained in insertion

techniques is a significant barrier to provision of LARC after childbirth[54] and after abortion. Because services work in silos, seamless provision of contraception after pregnancy, especially immediate postpartum provision of long-acting methods, is challenging—even in industrialized countries. For example, negotiating agreement over who should follow-up women after postpartum or post-abortion IUC insertion has proven surprisingly challenging in the UK.

It is worth being imaginative and flexible if it facilitates provision of an effective method that ensures prevention of unwanted pregnancy, particularly in vulnerable groups like adolescents, single mothers or drug-users. Postnatal insertion of POC implants in women's homes was evaluated in a cohort of 40 Scottish women; the service, provided by specially trained "contraceptive champion" community midwives was highly acceptable to the women.[55]

3 | CONCLUSION

The provision of contraception after pregnancy is not complicated but in the process of managing the pregnancy itself, it is something that is often forgotten completely or is rather poorly managed. Clear, evidence-based advice on which methods can be used and when they should be started is readily available on-line from the WHO, UK and US MEC.[18,20,21] The benefits of doing a good job are clear. Ensuring the availability of all contraceptive methods, facilitating uptake and ensuring correct and consistent use and method continuation are always challenging, but women/couples with a recent pregnancy are often highly motivated. Evidence is beginning to emerge on how best to organize services to allow provision of the most effective method acceptable to couples/women after pregnancy (whatever the outcome) and to do so at a time that is both convenient for the user and ensures high rates of method continuation and satisfaction. It takes flexibility and collaborative thinking on the part of service providers, but it is an investment that is well worth making.

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CONFLICT OF INTEREST

None.

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APPENDIX

The annual Capri Workshop (1-2 October 2018) discussed "Contraception after pregnancy". The lecturers included: Siladitya Bhattacharya (Head of the School of Medicine, Cardiff University School of Medicine, College of Biomedical and Life Sciences, Cardiff, UK), Johannes L.H. Evers (Professor of Obstetrics & Gynecology Research Institute GROW, Maastricht University and Academisch ziekenhuis Maastricht, Department of Obstetrics & Gynecology, Maastricht, the Netherlands), Kristina Gemzell-Danielsson (Chair Division of Obstetrics and Gynecology, Department of Women's and Children's Health, Karolinska Institutet, WHO-center, Karolinska University Hospital, Stockholm, Sweden), Anna Glasier (Simpson Center for Reproductive Health, University of Edinburgh, Edinburgh, UK), Sarah Hardman (Specialty Doctor SRH and Deputy Director of the FSRH Clinical Effectiveness Unit, Chalmers Center, Edinburgh, UK), Oskari Heikinheimo (Department of Obstetrics and Gynecology, University of Helsinki and Kätilöopisto Hospital, Helsinki University Central Hospital, Helsinki, Finland), Carlo La Vecchia (Department of Clinical Sciences and Community Health, Università degli Studi di Milano, Milan, Italy), Edgardo Somigliana (Clinica Ostetrica e Ginecologica, IRCCS Ca' Granda Foundation, Maggiore Policlinico Hospital, Milano, Italy). The chairs included: David T. Baird (Center for Reproductive Biology, University of Edinburgh, UK), Piergiorgio Crosignani (IRCCS Ca' Granda Foundation, Maggiore Policlinico Hospital, Milano, Italy), Eva Negri (Department of Biomedical and Clinical Sciences, Università degli Studi di Milano, Milano, Italy), and Annibale Volpe (Dipartimento Integrato Materno Infantile, Università di Modena, Modena, Italy).