ABSTRACT

Background: Many women with endometriosis have become pregnant through assisted reproductive technology (ART), and have often experienced placenta previa (PP) during pregnancy. The objective of this study was to assess the association between women with endometriosis, especially those who conceived with ART, and the risk of PP.

Methods: Two reviewers independently determined studies that were considered suitable for meta-analyses published in various medicine-related databases from March 1, 2004 through July 31, 2017 without language restrictions. Eight studies met the inclusion criteria, with a combined sample size of 21,930 women. Of these 21,930 pregnancies, 6,256 had endometriosis (endometriosis) and 15,674 had no endometriosis. Four of these studies included 8,161 women who conceived with ART, 1,640 of whom had endometriosis (endometriosis + ART), and 6,521 of whom did not have endometriosis. Meta-analyses were estimated with odds ratios (ORs) and 95% confidence intervals (CIs) using random effect analysis according to heterogeneity of studies.

Results: These meta-analyses showed women with endometriosis (endometriosis) have an increased risk of PP (OR, 4.038; 95% CI, 2.291 – 7.116; \( P = 0.000 \)). These results showed women who conceived with ART (endometriosis + ART), have a substantially increased risk of PP (OR, 5.543; 95% CI, 1.659–18.523; \( P = 0.005 \)).

Conclusion: These meta-analyses demonstrate women with endometriosis have an increased risk of PP.

Keywords: Endometriosis; Placenta Previa; Meta-analysis; Assisted Reproductive Technology

INTRODUCTION

Placenta previa (PP) is one of the diseases in which the placenta covers the internal os of the cervix and causes obstetric hemorrhagic complications during pregnancy and cesarean section.\(^1\) The incidence of this disease is about 0.3%–0.5%, and it is an important disease because it increases maternal and perinatal morbidity and mortality from massive bleeding.\(^2\) The risk factors for PP include a previous history of cesarean section, increasing...
Disclosure
Within the past 12 months, the authors had no financial relationships with any biotechnology manufacturers, pharmaceutical companies, or other commercial entities that have an interest in the subject matter or materials discussed in this manuscript.

Author Contributions
Conceptualization: Kim YS. Data curation: Jeon H, Min J. Formal analysis: Seo H, Kim S. Methodology: Min J, Kim DK. Software: Kim YS, Kim S. Validation: Kim YS, Jeon H. Investigation: Kim DK, Seo H. Writing - original draft: Jeon H. Writing - review & editing: Kim YS.

maternal age, multiple pregnancy, and smoking, and recent reports have indicated that assisted reproductive technology (ART) is also a cause. However, the pathogenesis of PP has not been clearly understood until recently. Most cases of PP should be delivered by cesarean section, not by vaginal delivery. Endometriosis is a chronic reproductive disease characterized by the presence of endometrial glands outside the uterus, mainly on the ovaries and peritoneum. The prevalence of endometriosis in women of reproductive age is about 6%–10%. Endometriosis causes two main symptoms, pain and infertility. It is well accepted that endometriosis of women with endometriosis is abnormal. Additionally, these abnormal endometrium may be the causes of decidual impairment and abnormal placentation during pregnancy. Endometriosis has been linked with increased peritoneal inflammation with a higher concentration of cytokines, angiogenic factors, and growth factors. Other harmful factors include poorer oocyte quality, progesterone receptor resistance, molecular and functional abnormalities in eutopic endometrium, and anatomical distortion of uterine posterior walls, fallopian tubes and ovaries in women with endometriosis. So, all of these processes may have negative impacts on pregnancy outcomes and fertility. However, studies on the relationship between PP and endometriosis have led to conflicting results, with some studies reporting a significantly increased risk of PP, and others showing no statistical significance, though in small sample sizes. Many women with endometriosis tend to have conceived with ART, though it is unclear whether the causes of the increase in PP are due to endometriosis, ART, or both. The objective of our study was to examine whether pregnant women with endometriosis are associated with an increased risk of PP.

METHODS
We developed a search strategy to use Medical Subject Heading (MeSH) terms and free key words and text words related to “endometriosis”, “pregnancy”, “adverse pregnancy outcomes”, “bad pregnancy outcomes”, “placenta previa”, “ART”, “in vitro fertilization (IVF)”, “intracytoplasmic sperm injection (ICSI)”, and “placental problems”.

We searched these terms using the PubMed MEDLINE database, the Korea education and research information service (KERIS), Scopus, and Google Scholar from March 1, 2004 through July 31, 2017 without language restrictions. The inclusion studies included a prospective cohort study, a retrospective cohort study, a retrospective case control study, a large national population-based cohort study, a retrospective secondary analysis, and double blinded, multicentric, observational and cohort studies, and a placebo-controlled, randomized clinical trial on the relations between endometriosis and pregnancy prognosis, while publications in abstract form alone were excluded. Data abstraction was completed by two independent investigators. Each investigator independently abstracted data from each study and analyzed these data separately.

Inclusion and exclusion criteria
The endometriosis group had pelvic endometriosis confirmed histologically and visually during the surgical procedure, or in two or more repetitive ultrasound examinations or magnetic resonance imaging (MRI) scans before pregnancy or after the operation. All patients who were clinically suspected to have pelvic endometriosis but with an absence of imaging or surgical confirmation were excluded from the endometriosis group. In this study, ART that was conducted by conventional IVF or ICSI was included. The gamete intrafallopian transfer (GIFT) women were excluded. The unexposed group included women who did not
have a previous surgical or clinical diagnosis of endometriosis, and who did not have any ultrasonographic signs of endometriosis. Women with malignancies, autoimmune diseases, endocrine diseases, and cardiovascular diseases were also excluded. Donor oocyte and embryo recipients were excluded. Miscarriages and terminations of pregnancy at < 20 weeks gestation were not registered as births. Late termination ≥ 20 weeks gestation and neonatal death (within 28 days of birth) were included.

Definitions
PP is defined as placental tissue completely obstructing internal os or within 20 mm. PP was confirmed at delivery. Confirmation of the diagnosis of PP was based on transvaginal ultrasonography with empty bladder performed prior to delivery. If the PP was not confirmed prior to delivery and there was a sudden unexpected birth, the diagnosis was confirmed at the time of delivery.

Statistical analysis
Differences were reviewed, and further resolved by a common review of the entire data set. Data abstracted included the number of study patients, the number of patients in endometriosis groups and control groups, and adverse pregnancy outcomes. When possible, authors of included trials were contacted for missing data. The risk of bias in each included study was assessed using the criteria outlined in the Risk of Bias Assessment Tool for Non-randomized studies (RoBANS). The following seven domains related to risk of bias were assessed in each included trial since there is evidence that these issues are associated with biased estimates of treatment effect: 1) random sequence generation, 2) allocation concealment, 3) blinding of participants and personnel, 4) blinding of outcome assessment, 5) incomplete outcome data, 6) selective reporting, and 7) other bias. The judgments of review authors were categorized as having a low, high, or unclear risk of bias.

Meta-analyses were performed with random effects models according to the heterogeneity of studies and we attempted to estimate the mean of a distribution of true effects. The completed analyses were then compared, and any differences were resolved with a review of the entire data set and independent analysis. Statistical heterogeneity between the studies was assessed using $I^2$ statistics. Heterogeneity was considered to be statistically significant if the $I^2$ value was more than 50%. Publication bias was evaluated by inspection of the funnel plot, Duval and Tweedie’s trim and fill, and Begg and Mazumdar’s rank correlation. Kendall’s tau value and Q value were adjusted to see a bias in publications. All effect sizes were calculated through Comprehensive Meta-analysis (CMA) ver.2.0 (Biostat Inc., Englewood, NJ, USA). Meta-analyses were estimated with odds ratio (OR) and 95% confidence interval (CI) using random effect analysis according to the heterogeneity of studies. A $P$ value less than 0.05 was considered to be statistically significant. The meta-analysis was performed following the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) statement.

RESULTS
Fig. 1 shows a flow diagram of how we identified relevant studies. A total of 246 articles were identified by searching the PubMed, the Embase, the Cochrane Library, and the KERIS. We excluded 45 duplicated articles and an additional 182 articles that did not satisfy the selection criteria. The full texts of the remaining 19 articles were reviewed, and 11 additional articles were excluded for reasons shown in Fig. 1. The remaining 8 articles were included in the final
analysis. The summary of characteristics of the enrolled studies included in these meta-analyses are in order. All of their RoBANS were a low and unclear risk of bias, and they were evaluated as good studies in the assessment of risk of bias (Table 1).

Meta-analyses were performed with random effects models according to the heterogeneity of eight studies (endometriosis) as we attempted to estimate the mean of a distribution of true effects. According to Kendall’s tau without continuity correction, the tau was −0.214, the Z value for tau was 0.742, the P value (1-tailed) was 0.228, and the P value (2-tailed) was 0.457. Also, as a result of Duval and Tweedie’s trim and fill, the point estimate was shown, and the Q value was 45.053. It was difficult to see if there was a bias in publications because the adjusted values and observed values of the studies were the same. Figure of the funnel plot for assessing publication bias for the risk of PP and endometriosis (endometriosis) is shown; it looks apparent that the funnel plot is symmetric (Fig. 2). Data from eight effect sizes from eight studies involving 21,930 patients were enrolled. These meta-analyses showed that women with endometriosis (endometriosis) have an increased risk of PP (OR, 4.038; 95% CI, 2.291–7.116; \(P = 0.000\), Fig. 3).

Meta-analyses were performed with random effects models according to the heterogeneity of four studies (endometriosis + ART) as we attempted to estimate the mean of a distribution of true effects. According to Kendall’s tau without continuity correction, the tau was 0.000, the Z value for tau was 0.000, the P value (1-tailed) was 0.500, and the P value (2-tailed) was 1.000. Also, as a result of Duval and Tweedie’s trim and fill, point estimate was shown, and the Q value was 19.282. Figure showed funnel plot for assessing publication bias for the risk of PP conceived by ART (endometriosis + ART); it looked apparent that the funnel plot was also symmetric (Fig. 4). It was difficult to see if there was a bias in publications. Data from four effect sizes from four studies involving 8,161 patients who conceived with ART were
Table 1. Summary of characteristics of enrolled studies included meta-analyses

| Study design | Healy et al. | Takemura et al. | Lin et al. | Tatsuya et al. | Benaglia et al. | Li et al. | Saraswat et al. | Berlac et al. |
|-------------|------------|---------------|-----------|---------------|----------------|---------|----------------|-------------|
| Type of study | Retrospective cohort study | Retrospective cohort study | Retrospective cohort study | Retrospective case control study | Retrospective cohort study | Retrospective cohort study | National population based cohort study | National cohort study |
| Type of conception | 1,265 ART+En+, 5,465 ART+En− | 44 ART+En+, 305 ART+En− | 249 non-ART+En+, 249 non-ART+En− | 92 ART+En+, 512 ART+En− | 239 ART+En+, 239 ART+En− | 1 ART+En+, 74 non-ART+En+, 300 non ART+En− | ART not distinguished | ART not distinguished |
| Site, year | Australia, 1991–2004 | Japan, 2004–2008 | China, 1995–2013 | Japan, 2000–2014 | Italy, 2008–2014 | China, 2011–2013 | Scotland, 1981–2010 | Denmark, 1997–2014 |
| Endometriosis surgery before pregnancy (type & time | NA (type & time: NA) | 44 (type & time: NA) | 249 (type: adhesiotomy, coagulation, cystectomy, time: NA) | 92 (type: cystectomy, removal of deep peritoneal nodules, time: NA) | 186 (78%) (type & time: NA) | 75 (type & time: NA) | 4,232 (type & time: NA) | 60 (type & time: NA) |
| Percentage of previous cesarean section (%) | NA | 0% ART+En+, 2.6% ART+En− | 84.8% ART+En+, 0% non-ART+En− | 90% ART+En+, 84% ART+En− | 100% En+, 58% En− | 72% En+, 58% En− | 67% En+, 54% En− |
| Percentage of nulliparity (%) | NA | 100% ART+En+, 97.4% ART− | 100% non-ART+En+, 100% non-ART− En− | 84.8% ART+En+, 100% ART+En− | 90% ART+En+, 84% ART+En− | 100% En+, 58% En− | 72% En+, 58% En− |
| Primary outcomes | Obstetric hemorrhage (APH, PP, PA, PPH) | PP | Adverse obstetric outcomes (preterm labor, PP, cesarean section, PH, SGA) | Adverse obstetric outcomes (preterm labor, PP, SGA) | Preterm birth | Adverse obstetric outcomes (PPH, preterm labor, PP, SGA, GDM) | Adverse obstetric outcomes (miscarriage, ectopic pregnancy, stillbirths, PH, APH, PPH, preterm labor, cesarean section) | The risk of obstetrical & neonatal complications |
| Diagnostic methods of endometriosis | NA | 44 Histopathology on surgery | 249 Histologically & visually on surgery | 90 Histopathology on laparoscopic surgery | 186 Histopathology on surgery, 53 transvaginal sonography | 75 Histopathology on laparoscopic surgery | 4,392 Surgically (laparoscopy or laparotomy) confirmed | 60 Histopathology on surgery |
| Sample size (No.) | 6,730 (1,265/5,465) | 349 (44/305) | 498 (249/249) | 604 (92/512) | 478 (239/239) | 375 (75/300) | 10,939 (4,392/6,547) | 1,957 (60/1,897) |
| Adjusted RR/ OR (95% CI) | 1.700 (1.220–2.404) | 13.347 (3.939–45.224) | 4.517 (2.839–6.844) | 12.095 (92/512) | 4.800 (2.39/239) | 1.66 (0.307–8.49) | 4,392 Surgically (laparoscopy or laparotomy confirmed) | 5.700 (1.518–3.036) |
| Risk of bias | Unclear | Low | Low | Low | Low | Low | Unclear | Unclear |

NA = not available, No = number of patients, En+ = endometriosis group, En− = control group, RR = risk ratio, OR = odds ratio, CI = confidence interval, ART = assisted reproductive technology, APH = antepartum hemorrhage, PP = placenta previa, PA = placental abruption, PPH = postpartum hemorrhage, PH = pregnancy induced hypertension, SGA = small for gestational age, GDM = gestational diabetes mellitus.
Endometriosis Increases Placenta Previa

Duval and Tweedie's trim and fill

|                  | Fixed effects | Random effects | Q value |
|------------------|---------------|----------------|---------|
|                  | Studies trimmed | Point estimate | Lower limit | Upper limit | Point estimate | Lower limit | Upper limit |         |
| Observed values  | 3.50632        | 2.94348        | 4.17680    | 4.03753     | 2.29078        | 7.11620    | 45.05037   |         |
| Adjusted values  | 0              | 3.50632        | 2.94348    | 4.17680     | 4.03753        | 2.29078    | 7.11620    | 45.05037   |

Begg and Mazumdar rank correlation

|                  | Kendall’s S statistic (P-Q) | Kendall’s tau without continuity correlation |
|------------------|-----------------------------|-----------------------------------------------|
|                  | −6.00000                    | Tau −0.21429                                   |
|                  |                             | Z value for tau 0.74231                        |
|                  |                             | P value (1-tailed) 0.22895                     |
|                  |                             | P value (2-tailed) 0.45790                     |
|                  |                             | Kendall’s tau without continuity correlation   |
|                  |                             | Tau −0.17857                                   |
|                  |                             | Z value for tau 0.21429                        |
|                  |                             | P value (1-tailed) 0.26809                     |
|                  |                             | P value (2-tailed) 0.53619                     |

Fig. 2. Funnel plot for assessing publication bias for the PP risk in women with endometriosis (endometriosis). PP = placenta previa.

Study or subgroup | (En+) Events | Total | (En-) Events | Total | Weight | OR, random, 95% CI | OR, random, 95% CI |
|------------------|-------------|-------|--------------|-------|--------|--------------------|--------------------|
|                  |             |       |              |       |        | Lower limit | Upper limit | Z value | P value |
| Healy et al.     | 10          | 48    | 1,265        | 126   | 5.465  | 17.69%     | 1.700    | 2.404   | 3.001   | 0.003   |
| Takemura et al.  | 11          | 9     | 305          | 3     | 4      | 10.09%     | 13.347   | 45.224  | 4.162   | 0.000   |
| Lin et al.       | 13          | 13    | 249          | 3     | 249    | 9.50%      | 4.517    | 16.544  | 2.276   | 0.023   |
| Tatsuya et al.   | 14          | 8     | 512          | 4     | 10.07% | 12.095     | 1.616    | 41.061  | 3.997   | 0.000   |
| Benaglia et al.  | 15          | 14    | 239          | 3     | 9.83%  | 4.800      | 1.369    | 16.824  | 2.451   | 0.014   |
| Li et al.        | 16          | 2     | 300          | 5     | 7.22%  | 1.616      | 0.307    | 8.499   | 0.567   | 0.571   |
| Saraswat et al.  | 17          | 72    | 6,707        | 4     | 17.39% | 2.240      | 1.518    | 3.306   | 4.062   | 0.000   |
| Berlac et al.    | 18          | 2     | 1,897        | 8     | 18.22% | 5.700      | 4.395    | 7.392   | 13.123  | 0.000   |
| Total (95% CI)   | 6,256       | 15,674| 100.00%      | 4.038  | 2.291  | 7.116     | 4.827    | 0.000   |
| Total Events     | 168         | 207   |              |       |        |           |          |          |          |

Heterogeneity: Tau² = 0.82; Chi² = 45.05, df = 7 (P = 0.000); I² = 84%
Test for overall effect: Z = 4.827 (P < 0.000)

Fig. 3. Forest plot of eight studies. The result of the PP risk in women with endometriosis (endometriosis). PP = placenta previa, OR = odds ratioo, CI = confidence interval.
These results showed that women with endometriosis who conceived with ART (endometriosis+ ART) have a substantially increased risk of PP (OR, 5.543; 95% CI, 1.659–18.523; \( P = 0.005 \)).

 included. These results showed that women with endometriosis who conceived with ART (endometriosis+ ART) have a substantially increased risk of PP (OR, 5.543; 95% CI, 1.659–18.523; \( P = 0.005 \), Fig. 5).
DISCUSSION

Endometriosis is a common and painful disease affecting women of reproductive age. While the underlying pathophysiology is still largely unknown, much advancement has been made in understanding the progression of the disease. A recent meta-analyses by Kim et al. demonstrated that primiparous singleton women with endometriosis at pregnancy have an increased risk of preterm birth (OR, 1.473; 95% CI, 1.216–1.785). In a study comparing the complications of pregnancy and delivery in pregnant women with endometriosis, it is important to distinguish between whether an accurate laparoscopic diagnosis was given before or after pregnancy and whether it was pregnancy through ART such as IVF/ET or ICSI. A retrospective analysis by Jeon et al. found that complete cul-de-sac obliteration is the independent factor of spontaneous pregnancy failure in women with endometriosis following laparoscopic surgery. In the process of embryo implantation in the endometriosis, inadequate uterine contractility called ‘endometrial waves’ observed in the sub-endometrial layer are thought to be the causes of PP. Population studies have found annual incidence rates of endometriosis ranging from 0.1–0.3. This reflects an increase in the diagnosis of endometriosis. According to the study on progesterone resistance in endometriosis conducted by Chae et al. in 2016, it may be caused by proinflammatory conditions in the pelvic peritoneal microenvironment. The biochemical materials associated in implantation include local and systemic inflammatory cytokines such as interleukin-6, interleukin-1β, and tumor necrosis factor-α. Additionally, the levels of prostaglandin E₂, cyclooxygenase (COX)-2 and various cytokines are highly elevated in endometriotic tissue relative to normal endometrium. The hypermethylation of progesterone receptor (PR)-B promotor and PR isoform A are also more expressed than PR-B as well as in endometriosis.

According to a retrospective analysis by Yang et al., endometriosis itself has worse IVF parameters regardless of previous cyst enucleation. In 2012, Vercellini et al. retrospectively assessed pregnancy outcomes in 419 women who achieved a first spontaneous singleton pregnancy following surgery for endometriosis, and stratified the results obtained by endometriosis localization. In this study, an almost six-fold increase in risk of PP has been found in women with rectovaginal endometriosis compared to all women with ovarian and peritoneal lesions (OR, 5.81; 95% CI, 1.53–22.03). Because a fixed abnormal anatomical uterine position owing to dense pelvic adhesions may theoretically reduce the efficacy of myometrial contraction, particularly in women with rectovaginal endometriosis, the risk of PP increases. In a small case–control study involving women with and without endometriosis matched for parity and ART procedures conducted by Kortelahti et al., no difference in PP incidence was found. However, the study likely had a very limited statistical power, as the number of placental abnormalities reported was very low. Conversely, two retrospective cohort studies conducted by Healy et al. and Kuivasaari-Pirinen et al. comparing the pregnancy outcomes of ART singleton pregnancies with those of natural pregnancies found higher rates of PP in the ART groups and in the various subgroups. The limitation of Healy et al.’s study was no information of previous section history, percentage of nulliparity, and diagnostic methods of endometriosis. Although the study was conducted on only ART pregnancies and may cause bias in the final statistics, it was included in this analysis due to a large number of samples. Kuivasaari-Pirinen et al. showed that mothers with endometriosis and those in the male factor infertility group have a greater incidence of PP than the reference group. One of the questions of this study is why ART increases the risk of PP. This study is consistent with other studies in that PP is increased in ART pregnancies. The underlying mechanism for this effect is not clear. In assisted fertilization, drugs are utilized to induce multiple follicular development. Fertilization and embryo development take place outside the body, and
embryos enter the uterine cavity through the cervix and vagina by mechanical means. With ART, embryos are placed in the uterine cavity by the transcervical route using a catheter. This procedure may induce uterine contraction, possibly due to the release of prostaglandins after mechanical stimulation of the internal cervical os. It is conceivable that these mechanically induced abnormal uterine contractions could lead to higher frequencies of implantation in the lower uterine segment and thereby increase the risk of PP. And, the normal frequency and amplitude of uterine contractions are altered in women with endometriosis, which may cause abnormal uterine dysperistalsis in endometriotic tissue leading to abnormal embryo implantation resulting in PP. These comorbidities in women with endometriosis who conceived with ART may increase the incidence of PP, not by ART itself.

In 2016, Tatsuya et al. tried to exclude the negative effects of ART on pregnancy by studying only women who conceived with ART. They also retrospectively investigated whether the severity of endometriosis was associated with increased complications of pregnancy conceived with ARTs. Endometriosis was classified according to revised American Society for Reproductive Medicine (rASRM) staging. They found that the frequencies of PP was significantly increased in women with laparoscopically diagnosed endometriosis (OR, 12.1; 95% CI, 3.6–41.1). The association between ovarian or rectovaginal endometriosis and the increased risks of PP involves the relationship between the severity of endometriosis and increased complications of pregnancy. The prevalence of bad pregnancy outcomes in the first pregnancy has been reported to increase compared to the next pregnancy, so this study has a strength in that it examined only nulliparous women.

We selected studies of women who underwent pre-pregnancy surgery, except for the study of Healy and others in 2010. The study of Healy et al did not show how endometriosis was diagnosed. And, while the study of Benaglia et al. in 2016 found that only 78% of women had surgery before conception, the other six had surgery all before pregnancy. And the percentage of nulliparity was from 52% to 100%. The diagnostic methods of endometriosis were histology except for 53 transvaginal sonography in the study of Benaglia et al. in 2016. Especially, both multiparity and previous cesarean section history have been known as important risk factors of PP. But, most of the studies included in our meta-analysis did not show previous C-section rates. It is assumed that it will be similar to the percentage of nulliparity. These factors may cause risk of bias in our analysis.

We would like to highlight the important findings and the significance of our analyses. The first strength of our study was that we analyzed the most recent studies available. The second strength of our study was that we performed the meta-analyses by separating the ART plus endometriosis group, taking into account that ART may affect PP development. The limitations of our study are that seven out of the eight studies used in the analysis indicated that endometriosis increased the incidence of PP, and the only other study was not significant. Because it is almost certain that PP increases in women with endometriosis, these analyses focused on how much it increases. The “unexposed” cohort can include some women with endometriosis undiagnosed by surgery or through imaging methods. These inclusion criteria thus tend to underestimate the risk of complications in women with endometriosis. Future research should focus on the use of fresh embryos and FETs and the type of infertility (tubal, ovulatory disorder, and male infertility) used in ART, as well as endometriosis localization (rectovaginal lesions, ovarian endometriomas, and peritoneal implants) and comparisons of the severity of endometriosis (classification of as rASRM stage I, II, III, and IV), followed by correction of maternal age and the study period, which will lead to better studies.
In conclusion, our study demonstrates that women with endometriosis have an increased risk of PP. We must increase international effort to understand the etiology and pathogenesis of endometriosis. Also, obstetrics should try to reduce complications in women with endometriosis from the time of conception to the postpartum period.

REFERENCES

1. Oyelese Y, Smulian JC. Placenta previa, placenta accreta, and vasa previa. Obstet Gynecol 2006;107(4):927-41.
2. Iyasu S, Saftlas AK, Rowley DL, Koonin LM, Lawson HW, Atrash HK. The epidemiology of placenta previa in the United States, 1979 through 1987. Am J Obstet Gynecol 1993;168(5):1424-9.
3. Ananth CV, Smulian JC, Vintzileos AM. The association of placenta previa with history of cesarean delivery and abortion: a metaanalysis. Am J Obstet Gynecol 1997;177(5):1071-8.
4. Ananth CV, Wilcox AJ, Savitz DA, Bowes WA Jr, Luther ER. Effect of maternal age and parity on the risk of uteroplacental bleeding disorders in pregnancy. Obstet Gynecol 1996;88(4 Pt 1):511-6.
5. Romundstad LB, Romundstad PR, Sunde A, von Düring V, Skjaerven R, Vatten LJ. Increased risk of placenta previa in pregnancies following IVF/ICSI; a comparison of ART and non-ART pregnancies in the same mother. Hum Reprod 2006;21(9):2353-8.
6. Giudice LC, Kao LC. Endometriosis. Lancet 2004;364(9447):1789-99.
7. Buck Louis GM, Hediger ML, Peterson CM, Croughan M, Sundaram R, Stanford J, et al. Incidence of endometriosis by study population and diagnostic method: the ENDOS study. Fertil Steril 2011;96(2):360-5.
8. Stratton P, Berkley KJ. Chronic pelvic pain and endometriosis: translational evidence of the relationship and implications. Hum Reprod Update 2011;17(3):327-46.
9. May KE, Villar J, Kirtley S, Kennedy SH, Becker CM. Endometrial alterations in endometriosis: a systematic review of putative biomarkers. Hum Reprod Update 2011;17(5):637-53.
10. Healy DL, Breheny S, Halliday J, Jaques A, Rushford D, Garrett C, et al. Prevalence and risk factors for obstetric haemorrhage in 6730 singleton births after assisted reproductive technology in Victoria Australia. Hum Reprod 2010;25(1):265-74.
11. Takekura Y, Osuga Y, Fujimoto A, Oi N, Tsutsumi R, Koizumi M, et al. Increased risk of placenta previa is associated with endometriosis and tubal factor infertility in assisted reproductive technology pregnancy. Gynecol Endocrinol 2013;29(2):113-5.
12. Lin H, Leng JH, Liu JT, Lang JH. Obstetric outcomes in Chinese women with endometriosis: a retrospective cohort study. Chin Med J (Engl) 2015;128(4):455-8.
13. Fujii T, Wada-Hiraide O, Nagamata T, Harada M, Hirata T, Koga K, et al. Assisted reproductive technology pregnancy complications are significantly associated with endometriosis severity before conception: a retrospective cohort study. Reprod Biol Endocrinol 2016;14(1):73-7.
14. Benaglia L, Candotti G, Papaleo E, Pagliardini L, Leonardi M, Reschini M, et al. Pregnancy outcome in women with endometriosis achieving pregnancy with IVF. Hum Reprod 2016;31(12):2730-6.
15. Li H, Zhu HL, Chang XH, Li Y, Wang Y, Guan J, et al. Effects of previous laparoscopic surgical diagnosis of endometriosis on pregnancy outcomes. Chin Med J (Engl) 2017;130(4):428-33.
16. Saraswat L, Ayansina DT, Cooper KG, Bhattacharya S, Miligkos D, Horne AW, et al. Pregnancy outcomes in women with endometriosis: a national record linkage study. BJOG 2017;124(3):444-52.
17. Berlac JF, Hartwell D, Skovlund CW, Langhoff-Roos J, Lidegaard O. Endometriosis increases the risk of obstetrical and neonatal complications. *Acta Obstet Gynecol Scand* 2017;96(6):751-60.

18. Kim SG, Seo HG, Kim YS. Primiparous singleton women with endometriosis have an increased risk of preterm birth: meta-analyses. *Obstet Gynecol Sci* 2017;60(3):283-8.

19. Jeon YE, Cho S, Lee KE, Yang HI, Seo SK, Kim HY, et al. Prognostic factors for predicting spontaneous pregnancy after laparoscopic surgical treatment of endometriosis. *Korean J Obstet Gynecol* 2009;52(12):1287-95.

20. Cha J, Sun X, Dey SK. Mechanisms of implantation: strategies for successful pregnancy. *Nat Med* 2012;18(12):1754-67.

21. Gylfason JT, Kristjansson KA, Sverrisdottir G, Jonsdottir K, Rafnsson V, Geirsson RT. Pelvic endometriosis diagnosed in an entire nation over 20 years. *Am J Epidemiol* 2010;172(3):237-43.

22. Chae U, Min JY, Kim SH, Ihm HJ, Oh YS, Park SY, et al. Decreased progesterone receptor B/A ratio in endometrial cells by tumor necrosis factor-alpha and peritoneal fluid from patients with endometriosis. *Yonsei Med J* 2016;57(6):1468-74.

23. Zanatta A, Pereira RM, Rocha AM, Cogliati B, Baracat EC, Taylor HS, et al. The relationship among HOXA10, estrogen receptor α, progesterone receptor, and progesterone receptor B proteins in rectosigmoid endometriosis: a tissue microarray study. *Reprod Sci* 2015;22(1):31-7.

24. Yang SH, Kim HO, Sung NY, Ahn HS, Choo YS, Yang KM, et al. In vitro fertilization outcomes in patients with advanced endometriosis after surgical treatment. *Korean J Obstet Gynecol* 2011;54(9):517-22.

25. Vercellini P, Parazzini F, Pietropaolo G, Cipriani S, Frattarolo MP, Fedele L. Pregnancy outcome in women with peritoneal, ovarian and rectovaginal endometriosis: a retrospective cohort study. *BJOG* 2012;119(12):1538-43.

26. Kortelahti M, Anttila MA, Hippeläinen MI, Heinonen ST. Obstetric outcome in women with endometriosis--a matched case-control study. *Gynecol Obstet Invest* 2003;56(4):207-12.

27. Kuivasari-Pirinen P, Raaktainen K, Hippeläinen M, Heinonen S. Adverse outcomes of IVF/ICSI pregnancies vary depending on aetiology of infertility. *ISRN Obstet Gynecol* 2012;2012:451915.

28. Smithers PR, Halliday J, Hale L, Talbot JM, Breheny S, Healy D. High frequency of cesarean section, antepartum hemorrhage, placenta previa, and preterm delivery in in-vitro fertilization twin pregnancies. *Fertil Steril* 2003;80(3):666-8.

29. Haas D, Wurm P, Shamiyeh A, Shebl O, Chvatal R, Oppelt P. Efficacy of the revised Enzian classification: a retrospective analysis. Does the revised Enzian classification solve the problem of duplicate classification in rASRM and Enzian? *Arch Gynecol Obstet* 2013;287(5):941-5.

30. Conti N, Cevenini G, Vannucchi S, Orlandini C, Valensise H, Gervasi MT, et al. Women with endometriosis at first pregnancy have an increased risk of adverse obstetric outcome. *J Matern Fetal Neonatal Med* 2015;28(15):1795-8.