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Prognostic evaluation and treatment strategies for cervical cancer in pregnancy: a systematic review and meta-analysis

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Objective This study was conducted to evaluate the prognosis of cervical cancer in pregnancy (CCIP) and analyze the clinicopathological factors affecting the prognosis of this cancer.

Data sources The studies published through July 2024 were systematically retrieved from PubMed, Embase, Web of Science, and Cochrane Library.

Study eligibility criteria The cohort studies, case-control studies, randomized controlled trials, and non-randomized controlled trials involving CCIP patients with data on 5-year overall survival (OS) were included in this study.

Study appraisal and synthesis methods The quality of the included studies was assessed using the Newcastle-Ottawa Scale (NOS). A meta-analysis was performed using Stata 15.0, focusing on the 5-year OS and relevant clinicopathological factors.

Results The results demonstrated that the 5-year OS of patients with CCIP was similar to that of non-pregnant patients with cervical cancer (RR = 1.00, 95% CI: 0.94–1.06, $P = 0.978$). The subgroup analysis results revealed that tumor size (≥ 4 cm), International Federation of Gynecology and Obstetrics (FIGO) stage (≥ IB2), and timing of diagnosis (postpartum) were prognostic factors with statistical significance ($P < 0.05$). However, such factors as pregnancy termination and timing of delivery did not significantly affect the 5-year OS ($P > 0.05$). The delivery mode required further validation despite its borderline significance ($P = 0.05$).

Conclusion The results of this study suggest that pregnancy does not exert a significant adverse effect on the long-term survival of patients with cervical cancer. Tumor size (≥ 4 cm), FIGO stage (≥ IB2), and time of diagnosis (postpartum) are identified as unfavorable prognostic factors for CCIP patients, while delivery mode requires further investigation. These findings provide strong evidence to support the optimization of personalized treatment strategies for CCIP patients.

Keywords Cervical cancer, Pregnancy, Prognosis, Perinatal period, Treatment

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Introduction

Cervical cancer in pregnancy (CCIP) refers to cervical cancer diagnosed during pregnancy, during delivery, or within six months after delivery. As the most common malignancy involving the female reproductive system during pregnancy, CCIP accounts for approximately 71.6% of all pregnancy-associated malignancies [1]. Despite this fact, CCIP remains extremely rare and has an incidence of 0.05-0.1% [2]. In recent years, the incidence of CCIP has been on the rise [3, 4], which may be attributed to the increasing maternal age and advancements in cervical cancer screening technologies [4].

The hormonal changes in estrogen, progesterone, human chorionic gonadotropin, and corticosteroids during pregnancy significantly alter the maternal immune state, making cervical cells more susceptible to the effects of carcinogenic factors, such as human papillomavirus (HPV) infection, thereby increasing the risk of malignant transformation [5, 6]. However, the unique physiological state of pregnancy can obscure the symptoms of this malignancy. Besides, tumor markers, influenced by hormonal changes, often show abnormal results, making it challenging to accurately identify the origin and severity of the tumor [7]. The therapeutic regimen for CCIP is influenced by multiple factors, including the patient's desire to maintain the pregnancy, tumor size, and International Federation of Gynecology and Obstetrics (FIGO) stage, which may impede the establishment of an optimal treatment protocol [8]. Moreover, the health of the fetus should also be considered in the formulation of therapeutic regimens, which complicates management, involving clinical decision-making, ethical considerations, and family preferences [9, 10].

Due to the rarity of CCIP, it is nearly impossible to conduct large-scale prospective studies. Consequently, existing guidelines are primarily proposed based on case reports and expert opinions [11]. Hence, there is an urgent demand for performing comprehensive explorations to clarify the management strategies and prognosis of CCIP. In this study, a meta-analysis was conducted to evaluate the prognosis of CCIP and explore clinical characteristics affecting the prognosis of this cancer through subgroup analyses. These scientific efforts are expected to provide more reliable evidence-based guidance for optimizing therapeutic strategies of CCIP.

Methods

This study was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) guidelines and registered in the International Prospective Register of Systematic Reviews, with the registration number being CRD42024571718 [12].

Retrieval methods

Relevant studies published through July 2024 were retrieved from multiple online databases, including Medline, Embase, PubMed, and Cochrane Library. To ensure comprehensive coverage, keywords such as "Cervical Cancer", "Prognosis", "Pregnancy", "Postpartum", "Puerperium", and "Treatment during pregnancy" were used, with the complete retrieval strategy provided in Supplement Fig. 1.

Inclusion and exclusion criteria

Inclusion criteria

The inclusion criteria included: (1) study population: patients who were pathologically diagnosed with CCIP and compared with non-pregnant women with cervical cancer in terms of their survival outcomes, without restrictions on age, nationality, ethnicity, or race; (2) outcome measure: 5-year overall survival (5-year OS); (3) relevant subgroup information: FIGO stage, timing of diagnosis, delivery mode, tumor size, timing of delivery, and pregnancy termination; (4) study design: cohort studies, case-control studies, randomized controlled trials, or non-randomized controlled trials.

Exclusion criteria

The exclusion criteria included: (1) reviews, editorials, letters, conference abstracts, commentaries, meta-analyses, case reports, and animal studies; (2) non-English studies; (3) duplicate publications or studies without the full text; (4) studies lacking the outcome measure of the 5-year OS; (5) studies reported in combination with other malignant tumors.

Study selection and quality assessment

The literature retrieval was conducted independently by two authors. Any discrepancies were resolved through discussion with a third author until a consensus was reached. The 14 studies included in this study [13–26] were subject to a quality assessment using the Newcastle-Ottawa Scale (NOS) recommended by the Cochrane Collaboration. The assessment criteria included the selection of study groups, comparability between groups, and outcome measurement, with a scoring range from 0 to 9. The studies with a score of ≥7 were considered to be of high quality. Only those with a score of ≥7 were included in this analysis.

Data extraction

Data extraction and verification were conducted independently by two authors. The extracted basic information included the first author, year of publication, country of the study, study design, study period, and main study outcomes. The primary outcome measure was the 5-year OS. To explore whether different

clinicopathological characteristics could affect the 5-year OS of CCIP patients, the patients were categorized into several subgroups based on key clinicopathological characteristics, including FIGO stage (<IB2 or ≥IB2), timing of diagnosis (diagnosis during pregnancy or the postpartum period), delivery mode (vaginal delivery or cesarean section), tumor size (<4 cm or ≥4 cm), timing of delivery (delayed delivery or non-delayed delivery), and pregnancy termination (termination of pregnancy or continuation of pregnancy). These clinicopathological characteristics were analyzed among these subgroups to assess their impacts on the 5-year OS of patients with CCIP.

Statistical analysis

All statistical analyses were performed with the aid of Stata 15.0. All results were presented as a 95% confidence interval (95% CI). Heterogeneity among the included studies was assessed using the Q test (Chi-square test) and the I^2 statistic. If the heterogeneity was low ($P \geq 0.1$, $I^2 \leq 50\%$), a fixed-effects model was adopted. If the heterogeneity was high ($P < 0.1$, $I^2 > 50\%$), a random-effects model was applied. The risk ratio (RR) for the 5-year OS was considered statistically significant if $P < 0.05$. During the analysis, a sensitivity analysis was conducted by sequentially removing individual studies and re-running the meta-analysis to assess their impact on the overall effect. If the effect size changed significantly after a study was removed, it indicated that the study had a substantial impact on the overall effect, and conclusions should be interpreted with caution. Publication bias was assessed using the Egger's test, Begg's test, and funnel plot analysis. A symmetric funnel plot indicated that there was no significant publication bias; while an asymmetrical funnel plot indicated the presence of publication bias to a certain degree, with the extent of bias proportional to the degree of asymmetry.

Results

Literature retrieval results

A total of 6,458 articles were identified through database retrieval after removing duplicates. After the titles and abstracts of these articles were screened, 26 articles were selected for the full-text review. A total of 20 studies were eligible for the systematic review. Among them, 14 studies were included in the meta-analysis based on their quality and relevance. The literature retrieval process is illustrated in Fig. 1.

Basic characteristics of included studies

All 14 studies were retrospective, with 4 studies from Europe, 7 from Asia, and 3 from North America. The sample size of these studies ranged from 21 to 9,048, including 13,965 patients in total. These studies were primarily conducted to investigate the impact of some factors on the 5-year OS, including pregnancy status, FIGO stage, timing of diagnosis, delivery mode, tumor size, timing of delivery, and pregnancy termination (Table 1). A total of 9 studies reported the comparison of the survival outcomes between CCIP and non-CCIP patients, with a primary focus on the 5-year OS [13–15, 17, 19, 21, 22, 24]. The impact of FIGO stages on the survival outcomes of CCIP patients was analyzed in 4 studies [17, 22, 23]; the impact of diagnosis timing on their survival outcomes was explored in 3 studies [16, 23]; the impact of delivery modes on their survival outcomes was examined in 4 studies [16, 17, 23]; the impact of tumor sizes on their survival outcomes was investigated in 2 studies [15, 23]; the impact of delivery timing on their survival outcomes was discussed in 2 studies [18, 23]; the impact of pregnancy termination on their survival outcomes was analyzed in 3 studies [15, 20, 24].

Quality assessment of included studies

The quality of the included studies was assessed using the NOS. The results showed that there were 12 studies with a score of 7 points and 2 studies with a score of 8 points. All studies had an NOS score of 7 or higher, indicating that the included studies were of high quality (Table 2).

Meta-analysis results

5-year OS in patients with CCIP versus non-CCIP patients

In 9 studies [13–15, 17, 19, 21, 22, 24], patients were divided into the CCIP group and the non-CCIP group. The 5-year OS was extracted and combined to calculate the RR. The heterogeneity test results (I^2 < 50%, $P = 0.208$) indicated low heterogeneity, and hence a fixed-effects model was applied. The combined effect size was presented as follows: RR = 1.00, 95% CI: 0.94–1.06, and $P = 0.978$. This result indicated that there was no statistically significant difference in the 5-year OS between the CCIP group and the non-CCIP group (Fig. 2).

Pregnancy termination

In 3 studies [15, 20, 24], patients with CCIP were divided into the pregnancy termination group and the pregnancy continuation group. The heterogeneity test results (I^2 < 50%, $P = 0.408$) indicated low heterogeneity, and hence a fixed-effects model was applied. The combined effect size was presented as follows: RR = 0.95, 95% CI: 0.85–1.07, and $P = 0.404$. This result indicated that there was no statistically significant difference in the 5-year OS between the two groups (Fig. 3).

Delivery mode

In 4 studies [16, 17, 23], patients with CCIP were divided into the vaginal delivery group and the cesarean section group according to delivery modes. The heterogeneity

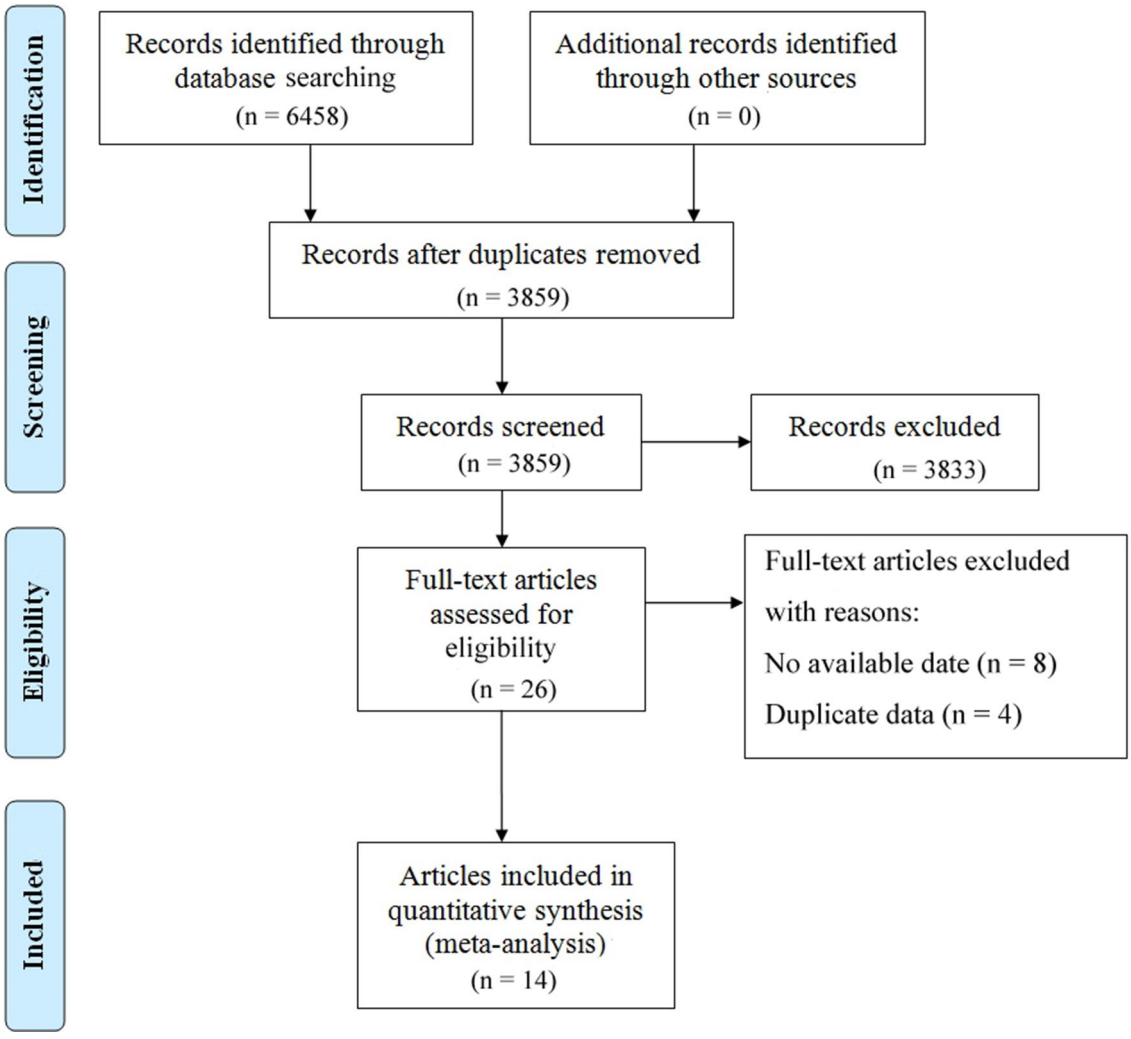

Fig. 1 Flow plot of the literature selection process

test results (I^2 > 50%, P = 0.081) indicated high heterogeneity, and hence a random-effects model was applied. The combined effect size was presented as follows: RR = 0.67, 95% CI: 0.45-1.0, and P = 0.05. This result proved borderline significance, suggesting that the vaginal delivery might affect the prognosis of patients with CCIP, but this finding was inconclusive (Fig. 4).

Tumor size

In 2 studies [15, 23], patients with CCIP were divided into the ≥ 4 cm group and the < 4 cm group according to the tumor size. The heterogeneity test results (I^2 < 50%, P = 0.744) indicated low heterogeneity, and hence a fixed-effects model was applied. The combined effect size was presented as follows: RR = 0.13, 95% CI: 0.03–0.62, and P = 0.01. This result indicated that the 5-year OS in the < 4 cm group was significantly higher than that in the ≥ 4 cm group (Fig. 5).

Timing of delivery

In 2 studies [18, 23], patients with CCIP were divided into the delayed delivery group and the non-delayed delivery group according to the timing of delivery. The heterogeneity test results (I^2 > 50%, P = 0.012) indicated high heterogeneity, and hence a random-effects model was applied. The combined effect size was presented as follows: RR = 0.91, 95% CI: 0.50–1.66, and P = 0.766. This result indicated that there was no statistically significant difference in the 5-year OS between the two groups (Fig. 6).

Timing of diagnosis

In 3 studies [16, 23], patients with CCIP were divided into the pregnancy diagnosis group and the postpartum diagnosis group according to the timing of diagnosis. The heterogeneity test results (I^2 < 50%, P = 0.842) indicated low heterogeneity, and hence a fixed-effects model was applied. The combined effect size was presented as

Table 1 Characteristics of studies included in this meta-analysis

Study, year	Country	Duration	Study design	Sample size	Age	Follow-up (months)	Outcomes
Baltzer 1990	German	Not Reported	Retrospective	466	< 43	> 60	pregnancy, timing of diagnosis
Bigelow 2016	USA	1997–2013	Retrospective	80	Mean:33.98	< 60	pregnancy, pregnancy termination
Germann 2005	France	1985–2000	Retrospective	21	Range: 28–43	2-165	FIGO stage, delivery mode, timing of delivery, timing of diagnosis, tumor size
Halaska 2019	European	1990–2012	Retrospective	388	Range: 21–45	2-269	pregnancy
Jones 1996	USA	1984–1990	Retrospective	59	Range: 21–50	> 60	FIGO stage, delivery mode
Lee 2008	Korean	1995–2003	Retrospective	84	Range: 21–50	> 72	pregnancy
Li 2020	China	2009–2017	Retrospective	105	Mean: 35	1-173	pregnancy termination
Li 2020	China (Taiwan)	2001–2015	Retrospective	9048	Range: 16–49	> 60	pregnancy
Ma 2019	China	2001–2006	Retrospective	92	Range: 18–40	> 60	FIGO stage, timing of delivery
Manuel-Limson 1997	Philippines	1961–1992	Retrospective	3258	Range: 19–48	> 36	pregnancy, FIGO stage, delivery mode
Sood 2000	USA	1960–1994	Retrospective	83	Not Reported	> 60	delivery mode, timing of diagnosis
Tang 2023	China	2007–2021	Retrospective	114	Mean:31.68	12–178	pregnancy, pregnancy termination, tumor size
Van der Vange 1995	Netherlands	1950–1987	Retrospective	44	Mean: 35.1	> 60	pregnancy
Zemlickis 1991	Korean	1985 – 1984	Retrospective	123	Mean: 34.0	> 60	pregnancy

Table 2 Quality assessment of included studies using the NOS

Studies	Selection				Comparability	Outcome			Scores
	Representativeness of the exposed cohort	Selection of the non-exposed cohort	Ascertainment of exposure	Outcome of interest not present at start of study	Comparability of cohorts on the basis of the design or analysis	Assessment of outcome	Follow-up long enough for outcomes to occur	Adequacy of follow up of cohorts	
Baltzer 1990	★	★	★	★	★	★	★	-	7
Bigelow 2016	★	★	★	★	★	★	★	-	7
Germann 2005	★	★	★	★	★	★	★	-	7
Halaska 2019	★	★	★	★	★	★	★	-	7
Jones 1996	★	★	★	★	★	★	★	-	7
Lee 2008	★	★	★	★	★	★	-	-	7
Li 2020	★	★	★	★	★	★	★	-	7
Li 2020	★	★	★	★	★★	★	★	-	8
Ma 2019	★	★	★	★	★	★	★	-	7
Manuel-Limson 1997	★	★	★	★	★	★	★	-	7
Sood 2000	★	★	★	★	★	★	★	-	7
Tang 2023	★	★	★	★	★★	★	★	-	8
Van der Vange 1995	★	★	★	★	★	★	★	-	7
Zemlickis 1991	★	★	★	★	★	★	★	-	7

follows: RR = 1.45, 95% CI: 1.13–1.85, and $P = 0.003$. This result indicated that the 5-year OS in the pregnancy diagnosis group was significantly higher than that in the postpartum diagnosis group (Fig. 7).

FIGO staging

In 4 studies [17, 22, 23], patients with CCIP were divided into the < IB2 stage group and the ≥ IB2 stage group according to FIGO staging. The heterogeneity test results (I^2 < 50%, $P = 0.752$) indicated low heterogeneity, and hence a fixed-effects model was applied. The combined effect size was presented as follows: RR = 2.03, 95% CI: 1.49–2.77, and $P < 0.001$. This result indicated that the 5-year OS in the < IB2 stage group was significantly higher than that in the ≥ IB2 stage group (Fig. 8). However, only two studies [22, 23] explicitly reported the FIGO staging system used, which were the 2018 and 2000 FIGO versions [27], while the other two did not specify the version of the FIGO staging system.

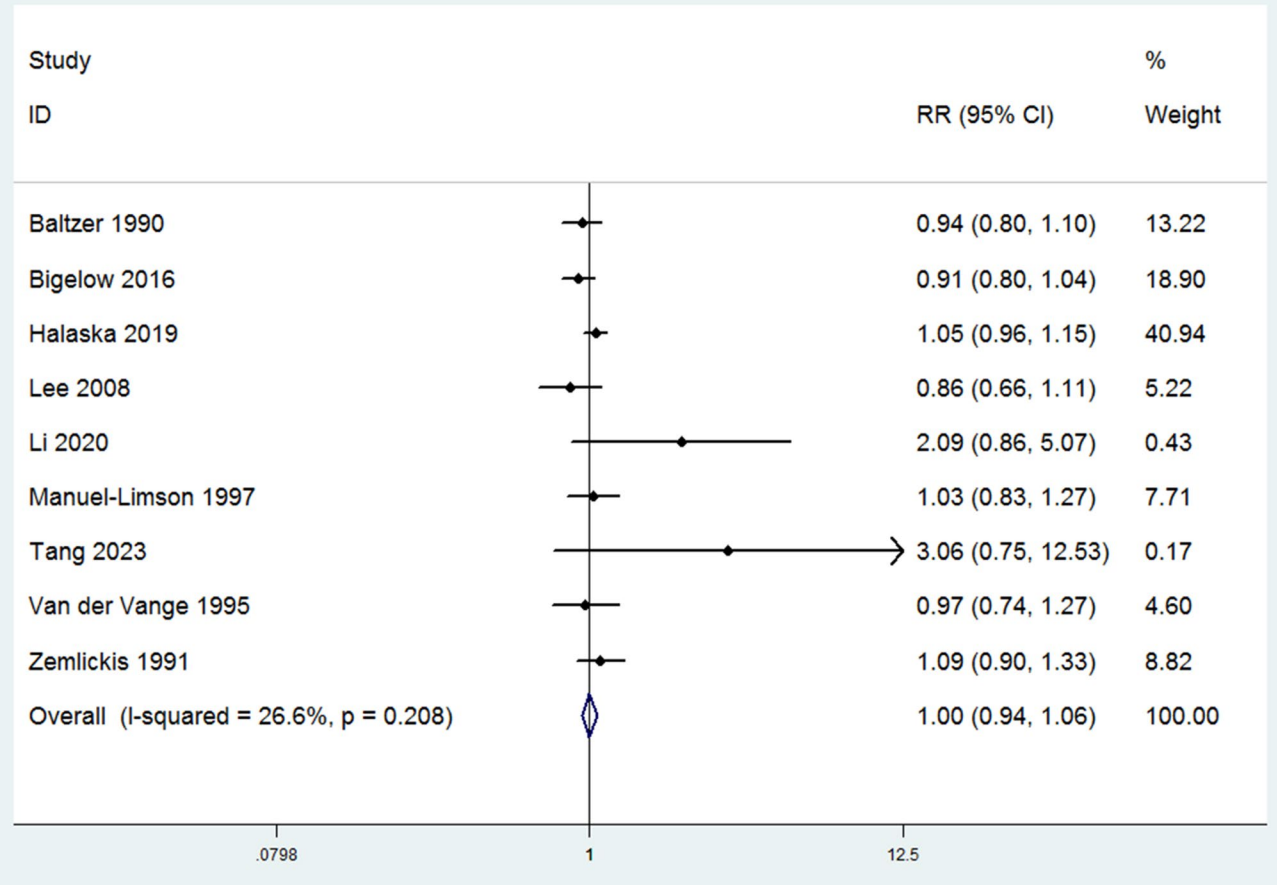

Fig. 2 Forest plot of 5-year OS in CCIP patients versus non-CCIP patients

Sensitivity analysis

To identify whether individual studies included in the analysis can affect the overall results, a sensitivity analysis was performed on the impact of pregnancy-related factors on the 5-year OS in patients with cervical cancer. Excluding any of the included studies did not significantly affect the results, indicating that the results of the random-effects model were robust and reliable in this study (Supplement Fig. 2).

Publication bias

Taking pregnancy-related factors as an example, a funnel plot was generated based on the 9 included studies (Supplement Fig. 3). These studies were evenly distributed on both sides of the combined effect size. However, most of the studies were located in the upper part of the funnel plot. To account for the risk of missing small-sample studies, the Begg's test and the Egger's test were conducted (Supplement Figs. 4 and 5). The *Z*-scores for the two tests were 0.348 and 0.331, respectively, with *P*-values greater than 0.05, indicating minimal publication bias. Moreover, the Begg's and Egger's test results for various subgroups also suggested that the publication bias was minimal (Supplement Table 1).

Discussion

In this study, the prognosis of patients with CCIP was evaluated, and the impact of various clinicopathological characteristics on the 5-year OS of these patients was also analyzed. The results showed that the 5-year OS of CCIP patients was similar to that of non-CCIP patients, suggesting that pregnancy did not exert a significant adverse effect on their long-term survival. The subgroup analysis results corroborated that the 5-year OS was significantly higher in patients with a tumor size less than 4 cm and lower FIGO stage (< IB2) and those diagnosed during pregnancy. Additionally, the delivery mode showed only borderline significance in the impact on the prognosis of these patients ($P = 0.05$). However, this finding suggested that delivery modes may affect outcomes, warranting further research.

There is a lack of high-quality evidence-based guidelines and unified treatment plans for CCIP. Currently, CCIP is primarily treated based on retrospective studies and expert consensus. The therapeutic regimen of CCIP should be formulated based on the FIGO guidelines, as well as guidelines from the National Comprehensive Cancer Network, International Gynecologic Cancer Society, European Society of Gynecological Oncology, and

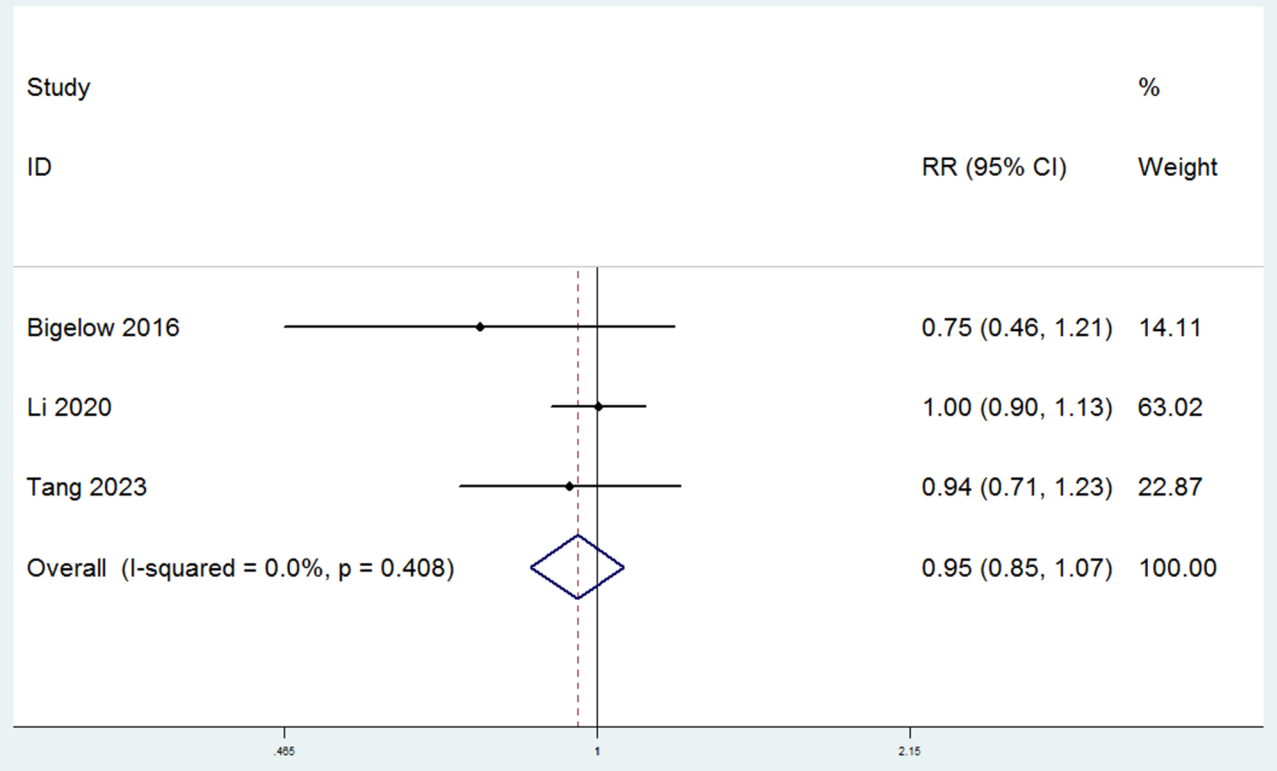

Fig. 3 Forest plot of the effect of pregnancy termination on 5-year OS in CCIP patients

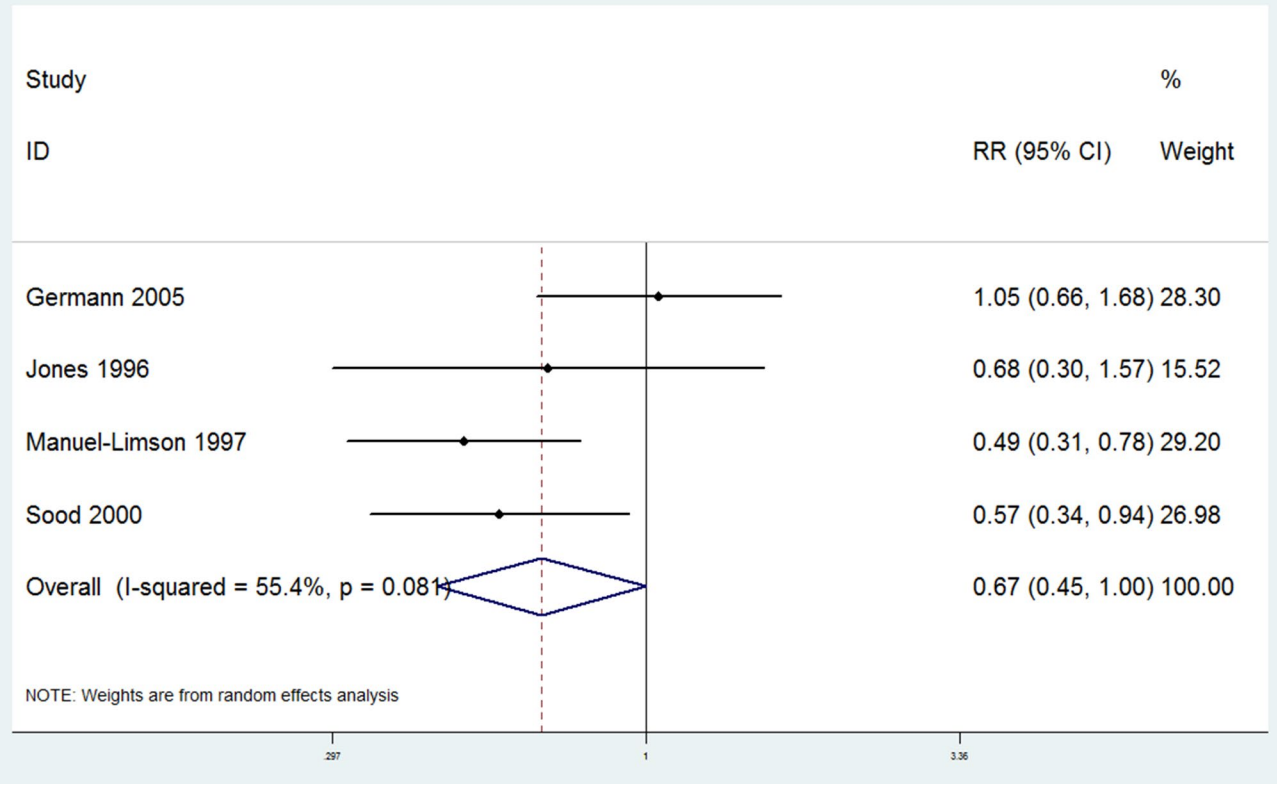

Fig. 4 Forest plot of the effect of delivery modes on 5-year OS in CCIP patients

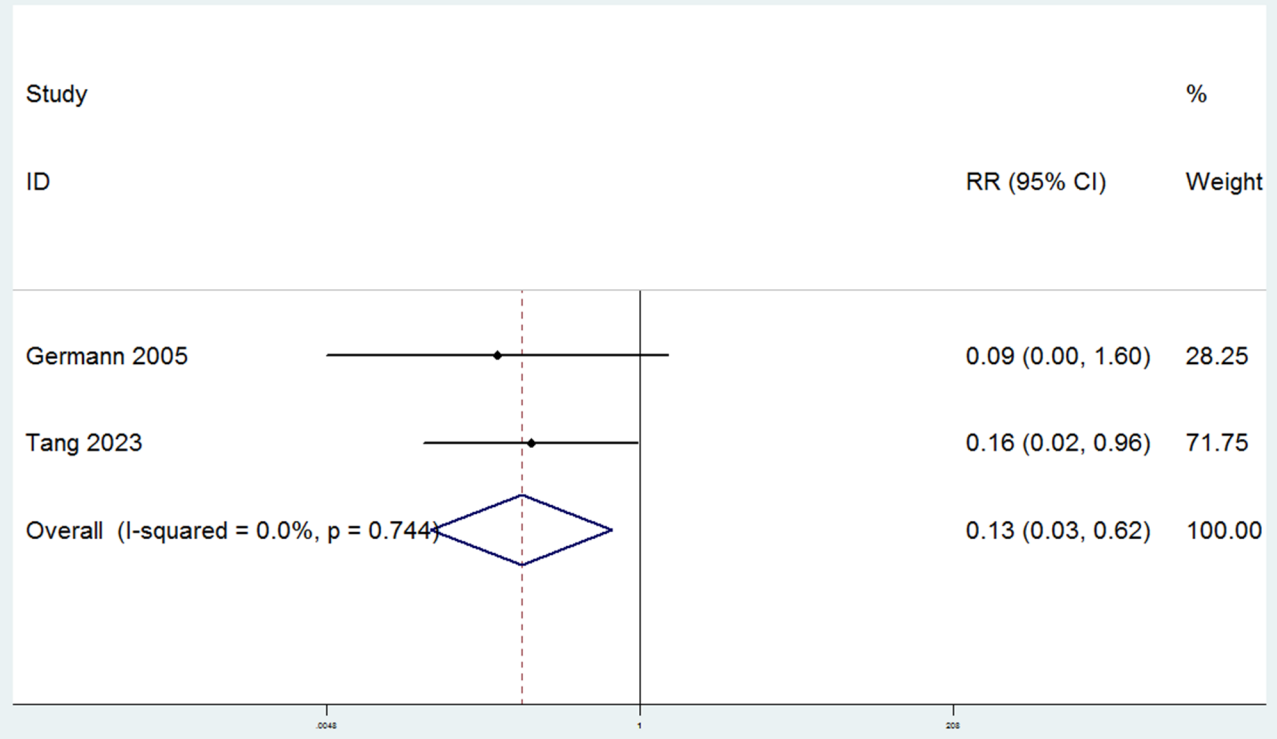

Fig. 5 Forest plot of the effect of tumor sizes on 5-year OS in CCIP patients

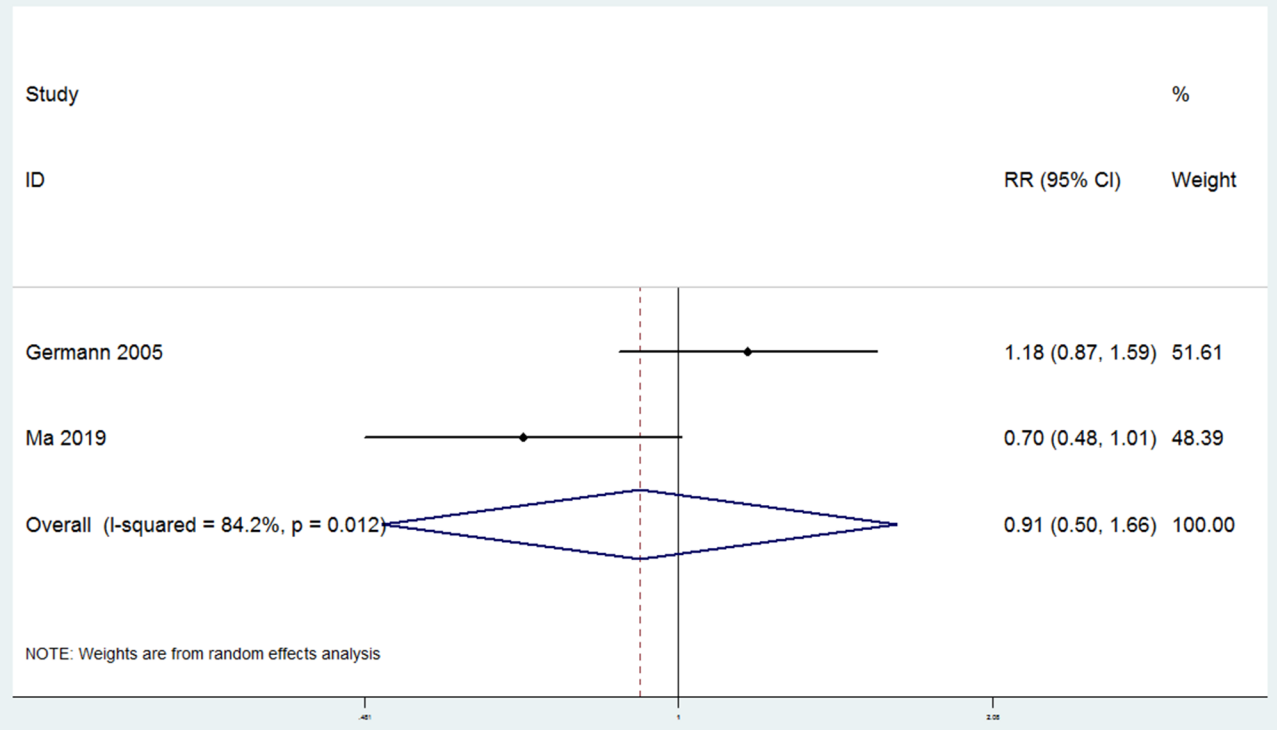

Fig. 6 Forest plot of the effect of delivery timing on 5-year OS in CCIP patients

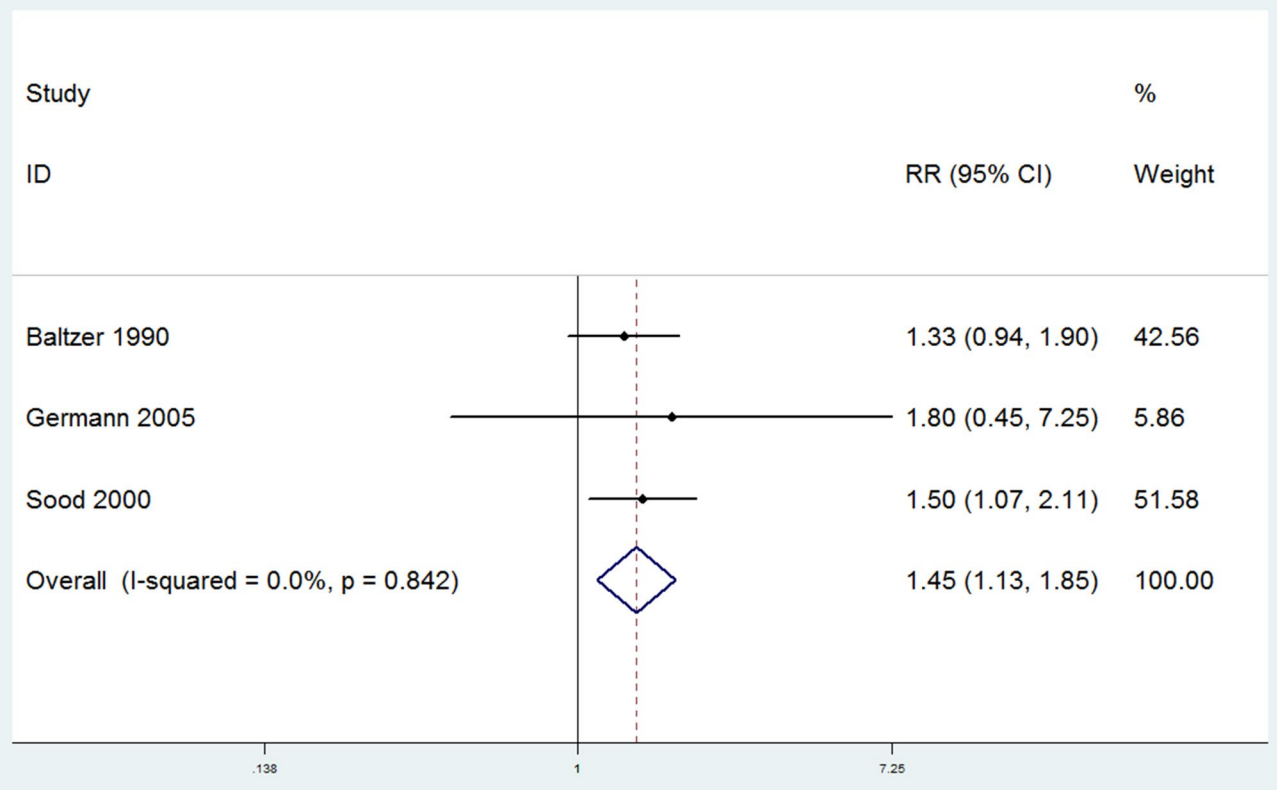

Fig. 7 Forest plot of the effect of diagnosis timing on 5-year OS in CCIP patients

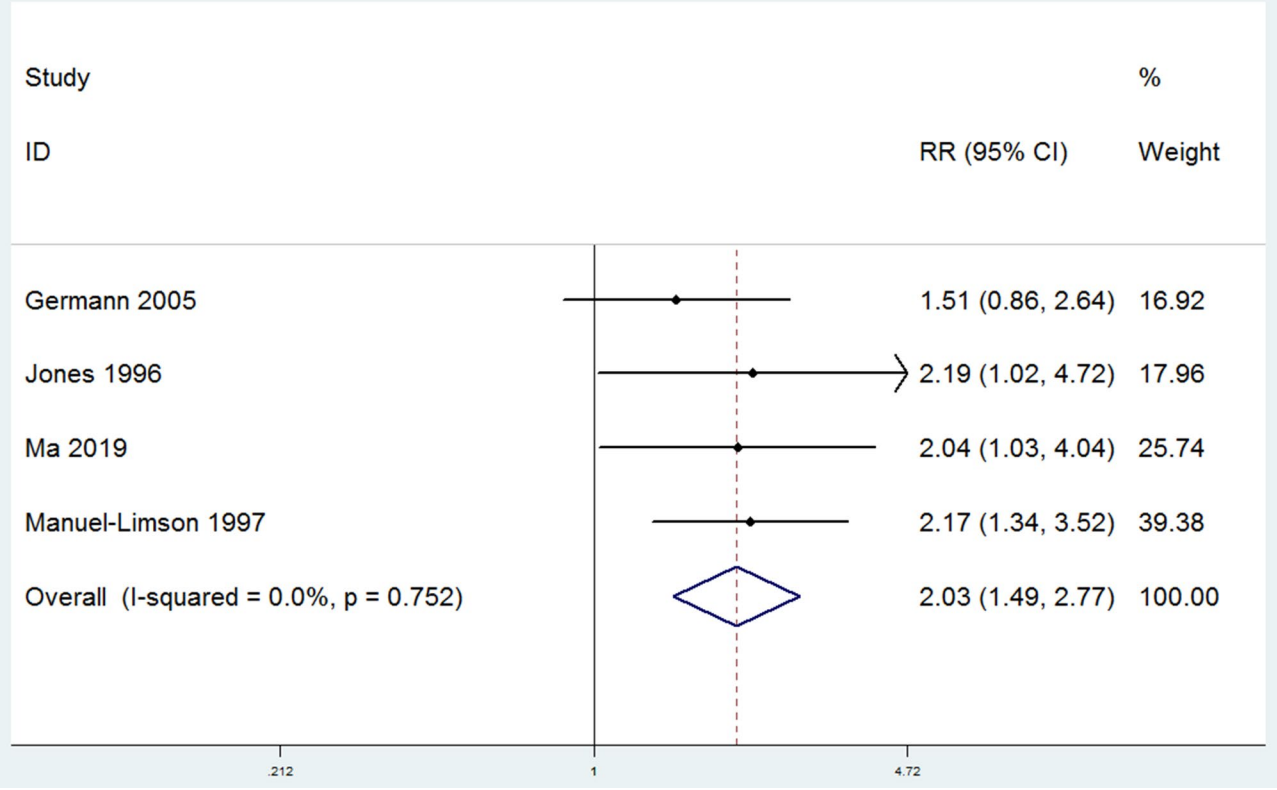

Fig. 8 Forest plot of the effect of FIGO stages on 5-year OS in CCIP patients

other organizations, and an individualized approach can be proposed by taking account of the disease stage, gestational age, and fetal development [6, 11, 28, 29]. For CCIP patients who have no desire to continue the pregnancy, management can be implemented as per the protocols for non-pregnant women with cervical cancer. For CCIP patients who have a desire to continue the pregnancy in the IA1 stage, if lymphovascular space invasion (LVSI) is negative, it is recommended to implement close monitoring and routine postpartum treatment, and cervical conization may be considered before 20 weeks of gestation [30]; if LVSI is positive, the treatment should be performed according to the protocols for patients in the IA2-IB2 stages [31]. The management of patients in the IA2-IB2 stages depends on the gestational age. Specifically, if the gestational age is less than 22 weeks, a laparoscopic evaluation of the lymph node (LN) should be performed [32, 33]. If the LN is negative, close monitoring and postpartum treatment are recommended; if the LN is positive, pregnancy termination and subsequent treatment are suggested. If the gestational age is 22 weeks or more, patients in all stages except for stage IB2, which requires neoadjuvant chemotherapy (NACT), can continue pregnancy with close monitoring [34]. For patients in the IB3-IVB stages, given the advanced stage of the disease, the management approach depends on the gestational age. Specifically, if the gestational age is less than 20 weeks, pregnancy continuation is generally not recommended [29]. However, if the patient has a strong desire to continue the pregnancy, chemotherapy may be considered after 14 weeks of gestation. In such cases, oncological treatment can be delayed until fetal maturity (if possible > 34 weeks of gestation) [35]. If the gestational age is 20 weeks or more, it is recommended to make treatment decisions based on a comprehensive evaluation of the patient's age, tumor stage, gestational age, and fetal development [29]. In our study, it was also found that FIGO staging and tumor sizes significantly affected the prognosis of patients with CCIP. As recommended in current guidelines, cesarean section can be recommended for patients with CCIP, and the metastasis of the placenta should be examined carefully during surgery. In our study, the impact of the delivery mode on the prognosis of patients with CCIP only showed borderline significance ($P = 0.05$). However, potential confounding factors such as tumor size, placental metastasis, or surgical complications were not explored. Vaginal delivery poses significant risks for patients with large and hard tumors or fragile, bleeding-prone exophytic lesions. For patients with small tumors, such as those in stage IA1, vaginal delivery may be considered. Some studies suggest that for patients with cervical cancer in stages IIA and above, vaginal delivery is linked to a higher recurrence rate and a lower survival rate, and episiotomy during vaginal delivery may increase the risk of tumor implantation and metastasis. Additionally, the risk of tumor implantation in abdominal scars during cesarean section warrants attention [16]. Therefore, further prospective studies based on larger scales, multiple centers, and long-term follow-up are needed to confirm the impact of delivery modes on the prognosis of patients with CCIP by considering these confounding factors.

Based on a comprehensive analysis of numerous articles, most studies have indicated that pregnancy does not exert an adverse impact on the prognosis of cervical cancer. Notably, Halaska et al. [36] and Jorine de Haan et al. [37] reported similar conclusions, further supporting that pregnancy cannot significantly alter the long-term survival outcomes of patients with cervical cancer. This may be attributed to the higher frequency of gynecological follow-up among pregnant women compared with non-pregnant women, which contributes to an earlier diagnosis and delayed progression of this disease [38]. Besides, our study demonstrated that there was no significant difference in the 5-year OS between the pregnancy termination group and the pregnancy continuation group. However, the decision to terminate pregnancy is inherently linked to the clinicopathological characteristics of the tumor and the selected treatment strategy. Therefore, for CCIP patients without high-risk factors (such as positive LN or late-stage tumors in early pregnancy) and with a strong desire to continue the pregnancy, pregnancy continuation under close monitoring is considered a relatively safe option. According to the results of this meta-analysis, delaying treatment to allow for sufficient fetal maturity does not appear to significantly affect the OS of CCIP patients. As reported in most studies, labor induction after 37 weeks of gestation is recommended to avoid complications related to prematurity and to ensure the full development of the fetal system [39, 40]. However, the results of some studies indicate that CCIP patients with delayed treatment may experience clinical progression [41, 42]. Therefore, obstetricians, neonatologists, and patients should carefully discuss the appropriate timing of delivery to balance maternal and infant health. In this study, it was also found that the 5-year OS of CCIP patients diagnosed before delivery was higher compared with those diagnosed after delivery. Therefore, it is necessary to highlight gynecological examinations during pregnancy. For patients presenting with irregular vaginal bleeding or discharge, a gynecological examination should be prioritized to rule out cervical pathology before considering obstetric factors.

Although the results of this study provide important insights into the diagnosis and treatment of CCIP, several problems require further exploration. (1) Relationship between pathological types and prognosis: The focus of existing studies is limited to clarifying the mechanism of

different pathological types to affect prognosis and identifying the optimal treatment strategies. Future studies should emphasize the diagnosis and treatment of high-risk pathological types, such as neuroendocrine carcinoma and PNET/Ewing sarcoma, to optimize patient management [43]. (2) Relationship between LN metastasis and prognosis: LN metastasis has been identified as a key factor influencing the prognosis of CCIP patients [44]. However, it remains unclear about the specific impact of different types of LN metastasis, such as the number and location of metastases, on the prognosis of CCIP patients [45]. Hence, more precise evaluation and management of LN involvement should be further investigated to improve patient outcomes. (3) Relationship between NACT and prognosis: It has been confirmed that NACT is effective in treating CCIP during mid-pregnancy, with no significant adverse effects on the mother or fetus [46]. However, different chemotherapy regimens are recommended by different guidelines. The 2014 guidelines from the International Gynecologic Cancer Society and European Society of Gynaecological Oncology suggest a three-week regimen of cisplatin combined with paclitaxel [47], while the 2019 Guidelines on Gynecologic Cancer During Pregnancy recommend either a weekly or three-week regimen of carboplatin combined with paclitaxel [11]. Hence, future research should be conducted to explore the safety and efficacy of these regimens, thus providing guidance for clinical practice.

The strength of this study lies in its systematic integration of several recent high-quality studies, providing a comprehensive evaluation of the prognosis and influencing factors of CCIP through a meta-analysis. The analysis results offer specific guidance for clinical practice. However, there are certain limitations in the study. (1) The included studies are primarily retrospective, and hence they are inherently subject to selection bias and information bias, potentially affecting the accuracy of the results. (2) For CCIP patients derived from these databases, treatment and follow-up information beyond literature records is not available. (3) Fewer histologic subtypes of CCIP and long-term fetal outcomes have not been fully clarified in existing studies. Future research should be performed based on large-scale, multicenter, and prospective cohorts with detailed treatment protocols and long-term follow-up.

Conclusion

In this study, it was found that the 5-year OS of CCIP patients was similar to that of non-CCIP patients. The subgroup analysis further identified that the tumor size (≥4 cm), FIGO stage (≥IB2), and timing of diagnosis (postpartum diagnosis) were significant prognostic risk factors. The delivery mode showed only borderline significance in this study ($P=0.05$), necessitating further investigations. These findings may provide important reference for the personalized management of CCIP patients. The focus of subsequent studies should be placed on high-risk pathological types, the assessment of LN metastasis, and the optimal application of NACT, thus optimizing treatment strategies for CCIP.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12885-025-13827-4.

Supplementary Material 1

Supplementary Material 2

Supplementary Material 3

Supplementary Material 4

Supplementary Material 5

Supplementary Material 6

Supplementary Material 7

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Author contributions
Siyuan Zeng prepared the original draft of the manuscript; Siyuan Zeng, Simin Xiao, Mingzhu Jia and Hu Zhao performed the statistical analysis; Lei Yu, Huiling Chen and Huiling Chen conducted a literature search.Xue Xiao reviewed and revised the article.

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Data availability
The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Declarations

Ethics approval and consent to participate
Not applicable.

Consent for publication
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Competing interests
The authors declare no competing interests.

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