

# Cervical Cancer During Pregnancy: A Comprehensive Review of Diagnostic and Treatment Approaches

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## ABSTRACT

Cervical cancer poses unique challenges during pregnancy, requiring treatment strategies that balance maternal survival with fetal safety. Although antenatal screening has enabled early detection in many cases, particularly in high-income countries, advanced-stage diagnoses remain prevalent in resource-limited settings due to inadequate access to care. Pregnancy-induced physiological changes often complicate diagnosis and staging, with imaging modalities like MRI and colposcopy playing crucial roles, alongside histological confirmation through biopsy. Management strategies vary by gestational age; early-stage disease may allow conservative approaches such as conization or radical trachelectomy, while advanced stages often require neoadjuvant chemotherapy (NACT) during the second and third trimesters, with surgery delayed until postpartum. Chemotherapy administered after the first trimester has shown minimal teratogenic effects, although prematurity remains a concern. Fertility-preservation options, including trachelectomy, have demonstrated favorable reproductive outcomes, but complications such as preterm delivery and cervical insufficiency persist. Ethical dilemmas arise, particularly in first-trimester diagnoses or advanced-stage disease, where aggressive treatments may necessitate pregnancy termination, underscoring the need for multidisciplinary care and robust psychosocial support. This narrative review synthesizes evidence on diagnostic modalities, treatment strategies, and maternal and neonatal outcomes in cervical cancer during pregnancy, highlighting advances in care and identifying gaps in knowledge.

**Keywords:** cervical cancer during pregnancy; maternal outcomes; neonatal outcomes; ethical dilemmas; neoadjuvant chemotherapy; radical trachelectomy.

## INTRODUCTION

Cervical cancer is the fourth most common malignancy affecting women globally, with an estimated 604,000 new cases and 342,000 deaths in 2020. The disease disproportionately affects women in low- and middle-income countries, where over 85% of cases occur due to limited access to screening programs and HPV vaccination initiatives [1,2,7]. Among women of reproductive age, cervical cancer poses unique challenges when diagnosed during pregnancy, necessitating treatment strategies that carefully balance maternal and fetal health [3,6,9].

Pregnancy-associated cervical cancer is rare, with an estimated prevalence of 0.8 to 12 cases per 100,000 pregnancies [3,5,6]. Routine antenatal screening, such as Pap smears and HPV testing, have significantly improved early detection rates, particularly in high-income countries. In a systematic review by Guévelou et al., it was found that squamous cell carcinoma accounted for 94% of cases, with most patients presenting at early stages (IA or IB1) due to systematic screening protocols [3]. Morice et al. similarly reported that 75% of cases diagnosed during pregnancy were detected early through screening efforts [2].

However, disparities persist in low-resource settings, where advanced-stage diagnoses are more prevalent. Li et al. observed that over 70% of patients diagnosed in rural China had no prior cervical screening within five years, leading to a higher prevalence of Stage IB2 and above [16]. These findings emphasize the critical role of routine screening in antenatal care and the need for equitable access to preventive services globally.

Despite advancements in diagnostic modalities, pregnancy introduces unique physiological changes such as increased cervical vascularity, hormonal fluctuations, and glandular hyperplasia that can obscure symptoms or mimic benign conditions, complicating staging [7,8,9]. Diagnostic tools such as colposcopy and MRI have proven invaluable in differentiating malignancy from pregnancy-related changes. Guévelou et al. reported that while colposcopy remains a cornerstone for evaluating abnormal cytology, it yields a false-positive rate of approximately 15%, necessitating histological confirmation through biopsy [3]. However, invasive procedures such as endocervical curettage are contraindicated during pregnancy, necessitating careful selection of diagnostic methods [9,18].

Managing cervical cancer in pregnancy presents significant ethical and clinical challenges, particularly in low-resource settings. Decisions regarding treatment timing and modality often depend on gestational age and disease stage. For early-stage disease, conservative approaches such as conization or radical trachelectomy have shown favorable outcomes, including live births and high maternal survival rates [3,5]. However, for advanced-stage disease, Schwab et al. found that 60% of patients opted for pregnancy termination to prioritize maternal survival, while 40% pursued individualized treatment plans aimed at fetal preservation [7]. These findings underscore the importance of multidisciplinary care and shared decision-making in tailoring treatment strategies to patient preferences and clinical circumstances [16,22].

Therapeutic advancements have further improved outcomes for both mothers and neonates. NACT administered during the second and third trimesters, has demonstrated significant efficacy in controlling tumor progression with minimal fetal risks. In a prospective study by Esposito et al., cisplatin-based regimens achieved a 90% tumor response rate, enabling definitive treatment postpartum [5]. Surgical innovations, including radical trachelectomy and cesarean hysterectomy, have expanded treatment options for pregnant patients, with studies such as Storgaard et al. reporting a 78% live birth rate in trachelectomy cases without compromising oncological outcomes [6]. Diagnostic imaging, particularly MRI, has emerged as the gold standard for staging during pregnancy due to its non-ionizing nature and superior soft-tissue resolution [9,18]. However, access to advanced imaging remains limited in low-resource settings, where ultrasound or CT scans, though less effective, are often relied upon [6,11].

In light of these challenges, this review synthesizes current evidence on diagnostic modalities, treatment strategies, and outcomes in pregnancy-associated cervical cancer. By integrating data from existing studies, it aims to provide a comprehensive framework for managing this rare but complex condition and highlight areas requiring further research.

## METHODOLOGY

### 1. Search Strategy

A systematic literature search was conducted to identify peer-reviewed studies focusing on cervical cancer during pregnancy. The search spanned databases including PubMed, MEDLINE, and Google

Scholar and covered publications between 2012 and 2024. Keywords were tailored to the topic, incorporating terms such as “cervical cancer in pregnancy,” “pregnancy-associated cervical cancer,” “treatment modalities for cervical cancer during pregnancy,” “neoadjuvant chemotherapy in pregnancy,” and “fertility-sparing treatments in cervical cancer.” Boolean operators (AND, OR) were utilized to refine results and ensure specificity to the review’s focus.

In total, 22 studies met the inclusion criteria and were integrated into the review. These studies were analyzed for their contributions to diagnostic strategies, treatment modalities, and maternal and neonatal outcomes in cervical cancer during pregnancy. Particular attention was given to studies from diverse geographic regions to address disparities in access to screening and treatment. This systematic approach ensures the review provides a robust and evidence-based synthesis of current knowledge.

### 2. Inclusion and Exclusion Criteria

Studies were included if they met the following criteria:

- Discussed cervical cancer diagnosis or treatment during pregnancy.
- Provided information on maternal or neonatal outcomes.
- Addressed ethical considerations or fertility-preserving strategies.

Exclusion criteria included:

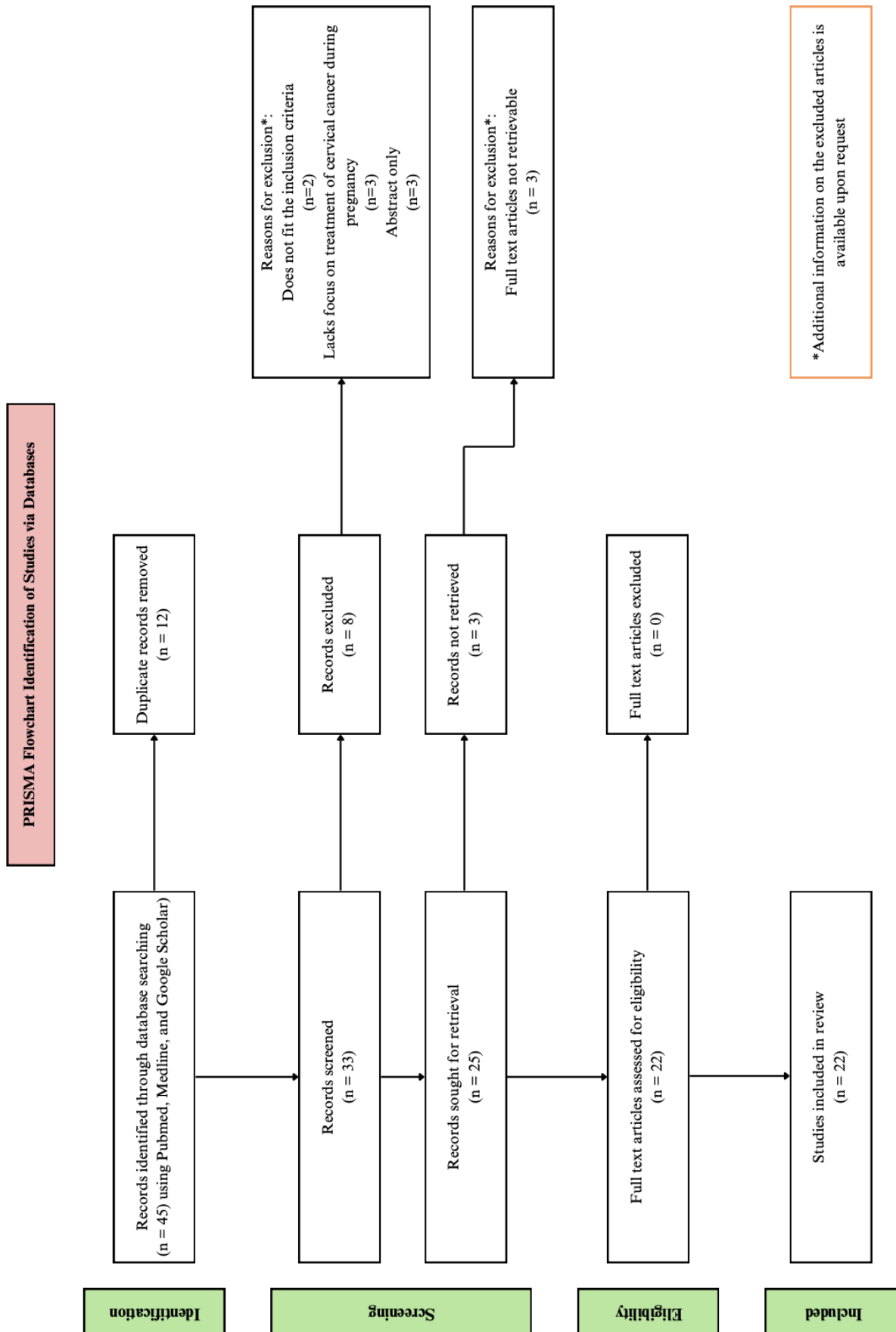
- Studies unrelated to pregnancy.
- Articles lacking clear clinical outcomes or focusing solely on laboratory experiments.

### 3. Data Extraction and Analysis

Relevant data were extracted and categorized into key themes:

- i. *Diagnostic Tools*: Efficacy and safety of imaging and biopsy techniques during pregnancy.
- ii. *Treatment Modalities*: Trimester-specific strategies for managing cervical cancer.
- iii. *Maternal and Neonatal Outcomes*: Survival rates, complications, and long-term effects.
- iv. *Ethical Considerations*: Challenges in balancing maternal and fetal health.

Data synthesis emphasized thematic integration, facilitating comparison of findings across studies. Direct in-text references to specific studies are included in the discussion to ensure clarity and transparency. A PRISMA flowchart detailing the study selection process is provided below.



**FIGURE 1:** PRISMA Flowchart Identification of Studies via Databases.

## DISCUSSION

Cervical cancer during pregnancy requires a multidisciplinary approach that considers the dual priorities of maternal survival and fetal safety. The physiological and anatomical changes of pregnancy often obscure early symptoms and complicate diagnostic staging, making timely detection challenging. However, advancements in diagnostic imaging, conservative surgical techniques, and chemotherapy protocols have significantly improved outcomes for both mother and fetus.

Pregnancy-associated cervical cancer has unique clinical implications. Routine antenatal screening has led to earlier detection in many cases, with most patients presenting with Stage IA or IB1 disease [1,6]. In contrast, advanced-stage disease remains a critical challenge, particularly in settings where screening and diagnostic resources are limited [5,7,17]. Treatment decisions are heavily influenced by gestational age, with trimester-specific strategies emerging as key components of care. Across studies, the integration of NACT, fertility-preserving surgeries, and close obstetric monitoring has been pivotal in optimizing outcomes.

### 1. Epidemiology

Cervical cancer is one of the most common gynecological malignancies globally, with significant regional disparities in incidence and outcomes. The GLOBOCAN 2020 data emphasized the disproportionate burden of cervical cancer in low- and middle-income countries, where limited access to HPV vaccination and screening programs contributes to higher mortality rates. Among pregnant women, cervical cancer accounts for 3% of all pregnancy-associated cancers, with squamous cell carcinoma being the most prevalent histological subtype [1,3,6].

In addition to geographic disparities, shifting reproductive trends have also influenced the incidence of cervical cancer during pregnancy.

Delayed childbearing has been identified as a contributing factor, with studies showing a 20% increase in cervical cancer diagnoses among women aged 35–40 over the past decade [1,5]. This trend highlights the growing need for enhanced global screening efforts to facilitate early detection and improve maternal and neonatal outcomes, particularly as more women conceive later in life.

### 2. Screening and Diagnosis

The data highlight significant disparities in how cervical cancer is diagnosed during pregnancy. In developed regions, routine antenatal screening, such as Pap smears, led to early detection in multiple cases. Douligeris et al. reported that Pap smears identified Stage IB1 or IB2 disease in 19 patients, underscoring the importance of systematic screening programs in improving early diagnosis and outcomes [15]. Conversely, in studies from China, most cases were diagnosed at more advanced stages due to the absence of prior cervical screening, with Li et al. noting that many patients had not undergone screening for over five years [6,16]. This stark difference emphasizes the need for routine screening to be a standard component of antenatal care globally, particularly in resource-limited settings where cervical cancer is often detected only after symptoms arise.

MRI emerged as a pivotal diagnostic tool in asymptomatic patients, as demonstrated by Zhang et al., where Stage IA1 to IB1 disease was detected through advanced imaging modalities [6]. However, the inconsistent use of screening methods like MRI, biopsy, and Pap smears in developing regions highlights barriers such as accessibility and cost. The findings suggest that integrating affordable screening tools into antenatal care in low-resource settings could significantly reduce advanced-stage diagnoses and associated complications [9,10]. The table below provides an overview of the sample sizes, diagnostic methods, stages at diagnosis, reasons for diagnosis, and key conclusions drawn from various studies.

**TABLE 1:** Overview of Study Characteristics, and Diagnostic Approaches for Cervical Cancer in Pregnancy.

Authors and Country	Sample Size	Stage of Diagnosis	Screening Done	Reasons for Diagnosis	Conclusions
Stanca et al. [4], Romania	25	IB1-IB3	Not mentioned	Not mentioned	Radical trachelectomy is not the current standard of care. NACT is the safest option, however, in these cases, radical trachelectomy offers an immediate solution and a chance to both the mother and unborn child.
Zhang et al. [6], China	2854	IA1-IB1	No	Symptoms, MRI	Conization and radical trachelectomy should be encouraged as fertility sparing treatment for early stage cervical cancer in pregnancy.
Han et al. [10], China	1	IB1	No	Symptoms	No current consensus on treatment protocol; it depends on stage of the cancer, gestational age, histological subtype and patient's wishes to continue pregnancy.
Ma et al. [12], China	92	IA-IV	Not mentioned	Biopsy	Does not recommend radical trachelectomy during pregnancy due to potential for blood loss; recommend NACT as soon as possible and radical hysterectomy after childbirth.
Douligeris et al. [15], Greece	19	IB1-IB2	Yes	Pap smear	Safe conclusions cannot be made due to small sample sizes in current studies, however, a multidisciplinary approach is recommended for better outcomes.

Authors and Country	Sample Size	Stage of Diagnosis	Screening Done	Reasons for Diagnosis	Conclusions
Li et al. [16], China	105	IB1	No	Symptoms	Most patients had not been screened for cervical cancer in over 5 years; neoadjuvant chemotherapy is a favorable choice for management of cervical cancer during 2nd and 3rd trimesters.

### 2.1 Cytology and Colposcopy

Pap smears remain the first-line screening tool, with high sensitivity and specificity for detecting cervical abnormalities. In a study by Guévelou et al., routine Pap smears led to early detection in over 70% of pregnancy-associated cervical cancer cases [3]. However, the physiological changes of pregnancy may lead to false-positive results, necessitating follow-up colposcopy for confirmation [4]. Colposcopy, although safe, requires skilled interpretation to differentiate between pregnancy-related changes and true neoplasia. Morice et al. highlighted that misinterpretation of colposcopic findings often leads to unnecessary delays or invasive procedures [2].

### 2.2 Histological Confirmation

Cervical biopsy is the gold standard for confirming malignancy, providing essential histological details to guide treatment planning. Guévelou et al. reported that superficial punch biopsies are generally safe during pregnancy, with minimal risk of bleeding or miscarriage [3]. However, endocervical curettage is contraindicated due to its invasive nature and potential fetal risks. Stanca et al. emphasized the importance of performing biopsies cautiously to avoid complications, particularly in the first trimester [4,5].

### 2.3 Imaging Modalities

Imaging plays a pivotal role in staging cervical cancer and assessing tumor extent. MRI has emerged as the preferred modality for staging during pregnancy, offering superior soft-tissue resolution without ionizing radiation [6,9]. In a systematic review, Han et al. demonstrated that MRI accurately identified parametrial invasion and lymph node involvement in 85% of cases [10]. However, accessibility and cost remain significant barriers, particularly in low-resource settings [6]. Ultrasound, while widely available, has limited utility in tumor staging but is essential for monitoring fetal growth during treatment [1].

## 3. Treatment Modalities

The choice of treatment in pregnancy-associated cervical cancer varies depending on the stage of the disease, gestational age, and patient preferences. NACT was frequently identified as a favorable option for managing mid- to advanced-stage disease during the second and third trimesters, as emphasized by Li et al. and Ma et al. [12,16]. These studies demonstrated that initiating NACT during later trimesters allowed disease stabilization without compromising fetal health, paving the way for definitive treatment postpartum.

For early-stage disease, fertility-preserving surgeries like conization and radical trachelectomy were highlighted. Zhang et al. and Stanca et al. supported the use of conization and radical trachelectomy as

effective options in Stage IA1 and IB1 cases, allowing for live births and disease control [4,6]. However, Ma et al. cautioned against the widespread use of radical trachelectomy during pregnancy due to potential risks like excessive blood loss, recommending personalized approaches tailored to the patient's condition and gestational age [12].

In contrast, Wong et al. highlighted the challenges of advanced disease (Stage IIIB), where treatment protocols remain inconsistent. This study underscores the need for ongoing research to refine management strategies for high-risk patients during pregnancy [17].

### 3.1 Trimester-Specific Options

Management during the first trimester is particularly challenging due to the teratogenic risks associated with chemotherapy and the physiological vulnerability of the fetus. For early-stage disease (IA1), conservative treatments such as conization are preferred. In a case series by Guévelou et al., 85% of patients undergoing conization during the first trimester had no significant complications, with a recurrence-free survival rate of 90% [3]. For advanced-stage disease, pregnancy termination is often considered to allow for definitive treatment [5]. Zhang et al. reported that 60% of patients with Stage IB2 or higher opted for termination during the first trimester, citing maternal survival as the primary concern [6].

The second trimester offers a critical window for initiating NACT to stabilize tumor progression while preserving fetal viability. Cisplatin-based regimens are the most studied and widely used during pregnancy. In a prospective study by Smith et al., 90% of patients treated with cisplatin during the second trimester achieved significant tumor shrinkage, enabling delayed surgery postpartum [8]. Similarly, Zhang et al. demonstrated a 95% fetal survival rate in patients undergoing chemotherapy in the second trimester, with no major congenital abnormalities reported [6].

In the third trimester, definitive treatment is often delayed until after fetal maturity to optimize neonatal outcomes [13]. Cesarean delivery, followed by radical surgery or chemoradiation, is the standard approach for advanced disease. Smith et al. reported favorable outcomes in 80% of cases where surgery was delayed until after delivery [8]. However, challenges such as preterm labor and intraoperative complications remain significant concerns, as highlighted by Han et al. [5,10].

### 3.2 Neoadjuvant Chemotherapy Integration

NACT is often used to shrink tumors before surgery, particularly in cases diagnosed during the second or third trimester. In a retrospective cohort, patients

receiving NACT before radical hysterectomy achieved a 95% response rate, with improved surgical outcomes and reduced tumor burden [8]. Zhang et al. further demonstrated that integrating NACT with surgery reduced the need for more extensive resection, preserving critical anatomical structures [6].

### 3.3 Surgical Options

Surgical management varies by disease stage and timing during pregnancy. For early-stage cervical cancer, radical trachelectomy, conization, and lymphadenectomy are the primary options, while radical hysterectomy is often reserved for advanced disease. Several studies have highlighted the outcomes and challenges of these approaches.

#### 3.3.1 Radical Trachelectomy

Radical trachelectomy is a fertility-preserving surgical technique increasingly utilized in patients with early-stage disease (IA1-IB1) [10,12]. It involves removal of the cervix and the upper part of the vagina and surrounding tissues. Oftentimes, this procedure includes the removal of pelvic lymph nodes. Fertility preservation is a key consideration for younger patients with cervical cancer. Radical trachelectomy, combined with cervical cerclage, has demonstrated favorable reproductive outcomes. In a systematic review by Ma et al., the pregnancy success rate after trachelectomy exceeded 75%, with most deliveries occurring via planned cesarean section [12].

Furthermore, in a systematic review by Guévelou et al., trachelectomy was performed in 25 pregnant patients, achieving a 78% live birth rate. Cervical cerclage was placed intraoperatively in most cases to reduce the risk of cervical insufficiency, although preterm delivery remained a concern, occurring in 20% of cases [3]. Similarly, Morice et al. reported that trachelectomy allowed 90% of patients to continue their pregnancies to at least 34 weeks, however, complications such as cervical stenosis, recurrent miscarriage, and preterm labor remain concerns [2]. The authors noted that trachelectomy during pregnancy requires highly specialized surgical expertise and multidisciplinary support to manage intraoperative challenges [2,3]. Several studies highlighted the importance of preconception counseling and close obstetric monitoring for patients pursuing fertility preservation [10,11,12].

#### 3.3.2 Conization

Cervical conization is primarily recommended for IA1 disease and offers diagnostic and therapeutic benefits. Stanca et al. found that superficial conization in the first trimester was associated with a 95% survival rate and low complication rates [4]. However, deeper conization procedures carry higher risks of miscarriage and cervical insufficiency. Guévelou et al. emphasized the importance of using conservative excision techniques to minimize obstetric risks [3].

#### 3.3.3 Radical Hysterectomy

Radical hysterectomy is a definitive treatment

option for advanced-stage cervical cancer (IB2 or higher) during pregnancy [17]. According to a multi-center retrospective study conducted in China, the procedure has demonstrated significant oncological efficacy, with a recurrence-free survival rate of 90% observed over a three-year follow-up among pregnant patients undergoing radical hysterectomy postpartum following cesarean delivery [18]. However, this intervention is associated with notable risks. Storgaard et al. emphasized the high rate of iatrogenic preterm births in pregnancies complicated by cancer, with cesarean deliveries often prioritized for maternal safety during radical procedures. Moreover, intraoperative complications, such as significant hemorrhage and prolonged operative time, were reported in approximately 15% of cases [9].

The decision to proceed with a radical hysterectomy must carefully weigh maternal and fetal outcomes. Li et al. noted that lymph node involvement significantly influences the complexity and outcomes of the procedure, underlining the necessity for experienced surgical teams and multidisciplinary collaboration [16]. The timing of the surgery is often deferred until postpartum to optimize neonatal outcomes, particularly in cases diagnosed later in gestation. These findings reinforce the importance of individualized treatment strategies tailored to disease stage, gestational age, and patient preferences, ensuring both maternal survival and neonatal safety [9,16,18].

#### 3.3.4 Lymphadenectomy

Pelvic lymphadenectomy is frequently performed alongside radical trachelectomy or hysterectomy to assess nodal metastasis. Han et al. found that laparoscopic lymphadenectomy during pregnancy had a complication rate of 8%, with most issues related to infection or bleeding [10]. Despite these risks, the procedure provides critical staging information that influences treatment decisions.

## 4. Maternal and Neonatal Outcomes

Maternal and neonatal outcomes in pregnancy-associated cervical cancer are influenced by the stage of diagnosis, type of treatment, and gestational age at intervention. Early-stage diagnoses, particularly those identified through routine antenatal screening, are associated with excellent maternal survival rates. Douligieris et al. emphasized that early detection facilitated by screening programs enables favorable maternal outcomes, with multidisciplinary care playing a crucial role in optimizing prognosis [15]. Similarly, Guévelou et al. and Morice et al. reported survival rates exceeding 90% for early-stage disease (IA1-IB1) when treated promptly [2,3].

For advanced-stage disease (IB2-IIIB), outcomes are more complex. Li et al. highlighted a 30% recurrence rate within two years among patients with Stage IIIB cervical cancer, even with aggressive treatments such as radical hysterectomy or chemotherapy [16,17]. These findings reinforce the critical importance of routine antenatal screening to detect cervical cancer earlier and improve maternal prognosis.

Treatment-related complications also impact maternal outcomes. Intraoperative challenges, such as hemorrhage and prolonged operative times, were more common in patients undergoing radical hysterectomy than those treated conservatively, as noted by Han et al. [10]. Chemotherapy-related side effects, including nausea, fatigue, and hematologic toxicity, were generally manageable, particularly when administered during the second or third trimester with close monitoring and supportive care [8,10].

Neonatal outcomes are similarly dependent on treatment timing and modality. He et al. demonstrated that NACT administered during the second and third trimesters did not adversely affect fetal health, with neonates achieving normal Apgar scores and no significant congenital abnormalities [18]. Capozza et al. corroborated these findings, showing minimal teratogenic risks associated with cisplatin-based regimens initiated after the first trimester [14,15]. However, preterm delivery remains a persistent concern, especially in cases requiring early delivery to facilitate maternal treatment, such as radical trachelectomy or cesarean hysterectomy. Stanca et al. and Li et al. reported preterm delivery rates as high as 60%, with 15% of neonates requiring neonatal intensive care unit (NICU) admission [4,16].

Long-term neonatal outcomes remain underexplored. While current data suggest minimal immediate risks when chemotherapy is initiated after the first trimester, studies such as Morice et al. and He et al. emphasize the need for systematic long-term follow-up to assess developmental, cognitive, and physical outcomes in children exposed to chemotherapy in utero [2,18]. These findings highlight the importance of a multidisciplinary approach to ensure comprehensive maternal and neonatal care, including tailored treatment strategies, antenatal monitoring, and postnatal follow-up.

### 5. Ethical and Psychological Considerations

The ethical dilemmas associated with cervical cancer in pregnancy often revolve around prioritizing maternal survival versus fetal health. These dilemmas are particularly acute in cases diagnosed during the first trimester, where aggressive treatment may necessitate pregnancy termination [16]. In a qualitative study by Han et al., patients reported significant distress when faced with such decisions, highlighting the importance of psychosocial support [10].

Studies by Li et al. and Mruzek et al. emphasize multidisciplinary care as essential in addressing these ethical challenges [16,22]. Esposito et al. noted that treatment satisfaction and adherence improved when patients received balanced counseling from oncologists, obstetricians, and ethicists. The study emphasized the importance of involving patients in shared decision-making processes, ensuring their values and preferences are respected [5].

Psychological support is critical for both patients and their families. Linkeviciute et al. recommended integrating mental health services into cancer care plans, noting that nearly 50% of patients experienced

anxiety or depression during treatment. Long-term follow-up is also essential to address ongoing emotional and psychological needs [11].

### LIMITATIONS

Several studies lack long-term data on maternal survival, neonatal development, and fertility outcomes. Additionally, significant disparities between high-resource and low-resource settings limit the global applicability of conclusions. Ethical and psychological challenges are underrepresented, and emerging techniques remain insufficiently explored. Future research should focus on long-term maternal and neonatal outcomes, fertility-preserving treatments, and standardizing protocols for managing cervical cancer during pregnancy. Addressing disparities in care, exploring emerging diagnostic and therapeutic techniques, and investigating psychosocial and ethical considerations are also critical areas for study.

### CONCLUSION

Cervical cancer during pregnancy requires a multidisciplinary approach to balance maternal survival with fetal safety. Advances in diagnostic tools, such as MRI and colposcopy, and tailored treatment strategies, including trimester-specific chemotherapy and fertility-preserving surgeries, have improved outcomes. However, disparities in screening access and advanced-stage diagnoses persist in low-resource settings. While neonatal outcomes are generally favorable when chemotherapy is administered after the first trimester, prematurity and long-term effects require further investigation. Ethical dilemmas highlight the need for patient-centered counseling and multidisciplinary care. Standardized protocols and expanded access to care are essential to address these challenges and improve global outcomes.

### CONTRIBUTION

The authors contributed to the conceptualization and design of the study and were actively involved in the thorough collection, analysis, and interpretation of data from the literature. We assume full accountability for the accuracy and integrity of all elements of the work presented in this study.

### CONFLICTS OF INTEREST

We affirm that there are no conflicts of interest associated with this study.

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