wjpmr, 2025, 11(4), 382-384

SJIF Impact Factor: 6.842

WORLD JOURNAL OF PHARMACEUTICAL AND MEDICAL RESEARCH

www.wjpmr.com

Review Article

ISSN 2455-3301

WJPMR

SCREENING, PREVENTION AND TREATMENT OF CERVICAL CANCER: RECENT ADVANCES AND GYNECOLOGICAL OBSTACLES

Dr. Swapnil M. Mane*[1], Dr. Prakash A. Aghav[2], Dr. Swati D. Karad[3] and Ananya Sharma[4]

[1,2]Research Fellow, Dr Mane Medical Foundation and Research Center, Rahuri, Dist. Ahmednagar, Maharashtra, India, 413705.

[3]Research Fellow, Dr Mane Medical Foundation and Research Center, Rahuri, Dist. Ahmednagar, Maharashtra, India, 413705.

[4]Research Fellow, Mane Medical Foundation and Research Center, Rahuri, Dist. Ahmednagar, Maharashtra, India, 413705.

***Corresponding Author: Dr. Swapnil M. Mane**

Research Fellow, Dr Mane Medical Foundation and Research Center, Rahuri, Dist. Ahmednagar, Maharashtra, India, 413705.

Article Received on 21/02/2025 **Article Revised on 11/03/2025** **Article Published on 01/04/2025**

ABSTRACT

Cervical cancer is a disease, which affecting female population globally belonging from reproductive age group. Cervical carcinogenesis involves an important role by high-risk types of HPV but also depends upon other risk factors of cancer. Development of cervical cancer is strongly associated with infection with high-risk human papillomavirus (HPV), although HPV infection alone will not induce the disease. The article summarizes existing preventive measures, screening and treatment of cervical cancer with emphasis to modern advancement. Surgical interventions, radiotherapy and chemotherapy conventionally have been utilized for managing cervical cancer. New technologies such as liquid-based cytology, artificial intelligence, precision medicine and molecular diagnostics hold potential to improve early detection and focused care. Breakthroughs in genetic editing, immunotherapy and biomarker science are also transforming future approaches.

KEYWORDS: Cervical Cancer, HPV, Carcinogenesis, Radiotherapy, Chemotherapy.

INTRODUCTION

Cervical cancer is the second most prevalent cancer in women worldwide, accounting for significant health burden related to the cancer incidences. Government and non-governmental interventions have been directed towards the prevention of cervical cancer over the years. Screening to detect and treat precancerous lesions was the initial focus, with prevention efforts now extended to include HPV vaccination. Cervical cancer is most strongly associated with chronic HPV infection, with other risk factors being smoking, long-term oral contraceptive use and early age sexual activity, etc. Cervical cancer is the third most frequent form of cancer among women globally and the second most frequent among women in developing nations. In the majority of low-income countries, it is the most common cause of cancer mortality among women. Though developed nations have experienced notable drops in incidence as well as death rates for cervical cancer during the last three decades. In rich economies, mass introduction of cytology screening, HPV testing and vaccination has resulted in dramatic declines in incidence.[1-4]

Pathophysiology

Development of cervical cancer is strongly associated with infection with high-risk human papillomavirus, although HPV infection alone will not induce the disease. The cancer mostly exists in two types depending on the origin of the cells as mentioned in **Figure 1**.

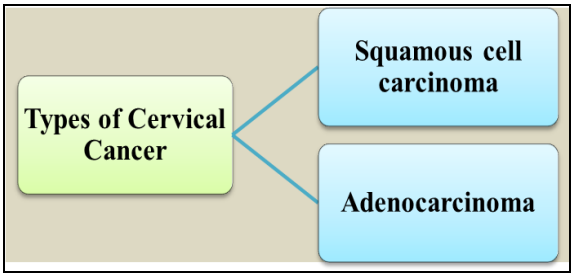

Figure 1: Types of cervical cancer depending on the origin of the cell.

As mentioned above squamous cell carcinoma develops from the flat outer cells of the cervix while adenocarcinoma develops from glandular cells covering the cervical canal. In some cases, both squamous and glandular cells are involved. Other cell types in the cervix can occasionally give rise to cancer, though this is

uncommon.

Cervical carcinogenesis generally involves a sequence from normal tissue to precancerous lesions defined as cervical intraepithelial neoplasia. Mild, moderate and severe are the different stages of these, which can further progress towards invasive squamous cell carcinoma if left untreated. The major challenge is to differentiate between low-risk, non-progressive lesions and high-grade lesions with higher potential for malignancy.[4-6]

Cervical cancer starts when healthy cells in the cervix develop genetic changes that change their DNA. These alterations make the cells grow out of control and resist programmed cell death, resulting in tumors. These cancer cells can eventually invade surrounding tissues and spread to other areas of the body. Although HPV is the most prevalent risk factor for cervical cancer and it is primarily transmitted by sexual contact. Persistent infection may produce cellular alteration that can develop into cancer.

Risk factors

Cigarette smoking increases the risk for cervical cancer. HPV infection in smokers also lasts longer and does not clear as easily as it does in nonsmokers. The risk of developing HPV and thus cervical cancer increases with the number of sexual partners. Early initiation of sexual activity at a younger age puts individual at greater risk of getting HPV, which can cause cervical changes over time. Certain infections like herpes, gonorrhea, chlamydia, HIV and syphilis make an individual prone to HPV infection, hence elevating cervical cancer risk. Impaired immune system and prenatal exposure to diethylstilbestrol also increases risk of acquiring cervical cancer.[5-7]

Prevention

- Vaccination for the human papillomavirus can significantly reduce risk of getting cervical and other types of cancers due to HPV.
- Routine Pap screening can detect precancerous changes in cervical cells, which can be watched closely or treated to prevent the development into cancer.
- Safe sex habits; using protective barriers and reducing number of sexual partners, etc. also help to prevent pathological triggering of cervical cancer.
- Avoid smoking habits reduces risk of cervical cancer.

Conventional Treatment

Surgery is a major and efficient treatment for cervical cancer in the early stages by removing malignant tissue physically. It is also suitable in some cases of metastasis. The available surgery depends on the stage and spread of the cancer. Total and radical hysterectomy involves removal of cervix and uterus, with or without the ovaries. Radical hysterectomy involves resection of the uterus, cervix and upper part of the vagina. Fertility preserving procedures such as "Loop Electrosurgical Excision Procedure", conization and trachelectomy get rid of cervical cancer by maintaining fertility. Conization removes a cone-shaped section of the cervix, encompassing the transformation zone and usually necessitates hospital admission. Radical trachelectomy resects the cervix, surrounding tissues and upper vagina using laparoscopic or robotic methods.

Radiotherapy with high-energy radiation is one of the primary modalities in the treatment of cervical cancer. It comprises; external beam radiation therapy, intensity modulated radiotherapy and brachytherapy. External beam radiation therapy is most widely practiced technique, in which beams of radiation are administered from outside the body to the tumor site. Intensity modulated radiotherapy is a highly accurate approach, in which radiation beams are shaped according to the size and shape of the tumor, further improving accuracy and minimizing damage to nearby tissues. Brachytherapy provides high-dose radiation to the tumor directly or by inserting a radioactive source within the diseased area, sparing surrounding healthy tissues. Imaging modalities such as CT and MRI have improved tumor localization, enhancing treatment planning.

Chemotherapy is an integral part of cervical cancer treatment, utilized in various modes including as adjuvant treatment after surgery to reduce recurrence risk when there are poor prognostic indicators. It also used with radiotherapy particularly in locally advanced cases, to improve results and reduce recurrence risk. Chemotherapy used for advanced cervical cancers, increases response rates and administered in multi-drug regimens to prolong survival. Chemoradiotherapy has been established in systematic reviews to increase overall as well as progression-free survival and decrease rates of recurrence.[6-8]

Modern Approaches

Recent advances in technology have played an important role in the prevention, diagnosis and treatment of cervical cancer. Thermal ablation uses heat to kill precancerous cervical tissue and has promising potential for decreasing cervical cancer incidence. Liquid-based cytology, with automation, enhances specimen quality and laboratory productivity, enables HPV testing, and allows automated interpretation, thus simplifying the screening process. The point-of-care HPV molecular test has a key role in allowing healthcare providers to deliver immediate post-test counseling to women who test positive for HPV. This is also complemented by technologies like self-sampling and high-resolution microendoscopy.

Advances in molecular screening especially *via* genomic profiling of oncogenes and tumor suppressor genes have improved the identification of high-risk HPV DNA and promises more accurate risk assessment. Furthermore, artificial intelligence is transforming cervical cancer

screening by augmenting diagnostic accuracy, allowing non-invasive disease differentiation, and facilitating efficient triaging of HPV-positive individuals through real-time, automated evaluations. **Table 1** depicted comparative approaches for the management of cervical cancer.[7-10]

Table 1: Comparative approaches for the management of cervical cancer.

Treatment Modality	Advantages	Disadvantages
Immunotherapy	Boosts immune response against cancer cells Improved survival in positive cases Less toxic than traditional chemotherapy	Only effective in biomarker-specific patients Expensive and Risk of immune-related side effects
Targeted Therapy	Targets tumor blood supply Improves overall survival	May cause hypertension, bleeding, or intestinal perforation Less effective in certain cancer subtypes
HPV Therapeutic Vaccines	Potential non-invasive future alternative Induces long-term immune memory	Limited clinical access Long-term efficacy/safety data not available.
Proton Beam Therapy	Highly targeted treatment spares healthy tissue Fewer long-term side effect	Very expensive and rare availability

CONCLUSION

Vaccination and early detection of precancerous alterations are major approaches to prevent cervical cancer. However, for women presenting with invasive disease, early access to specialty care is necessary for cure. Conventional treatments for cervical cancer, includes radiotherapy, chemotherapy and surgery which remain the cornerstone of management, particularly in early and locally advanced stages. These methods aim to eliminate malignant tissue, preserve organ function when feasible, and reduce recurrence. With the integration of advanced imaging, precision radiotherapy techniques and combined chemo-radiotherapy protocols treatment outcomes have significantly improved. Modern approaches ranging from thermal ablation and molecular diagnostics to AI-assisted screening and targeted therapies are revolutionizing prevention and early detection.

REFERENCES

1. Newfield EA, Borella KS, Baucom MP, Madden WT, Holland AC, Lee LT. Cervical cancer screening uptake among medically underserved women. Womens Healthcare, 2023; 11: 24–9.
2. Ganesan S, Subbiah VN, Michael JC. Associated factors with cervical pre-malignant lesions among the married fisher women community at Sadras, Tamil Nadu. Asia Pac J Oncol Nurs., 2015; 2: 42–50.
3. Hull R, Mbele M, Makhafola T, Hicks C, Wang SM, Reis RM, et al. Cervical cancer in low and middle-income countries. Oncol Lett., 2020; 20: 2058–74.
4. Bhatla N, Meena J, Kumari S, Banerjee D, Singh P, Natarajan J. Cervical Cancer Prevention Efforts in India. Indian J Gynecol Oncol, 2021; 19: 41.
5. Wu J, Zhao Y, Li F, Qiao B. MiR-144-3p: a novel tumor suppressor targeting MAPK6 in cervical cancer. J Physiol Biochem, 2019; 75: 143–52.
6. Kombe Kombe AJ, Li B, Zahid A, Mengist HM, Bounda GA, Zhou Y, et al. Epidemiology and Burden of Human Papillomavirus and Related Diseases, Molecular Pathogenesis, and Vaccine Evaluation. Front Public Health, 2021; 8: 552028.
7. Gaete S, Auguste A, Bhakkan B, Peruvien J, Herrmann-Storck C, Socrier Y, et al. Frequent high-risk HPV co-infections excluding types 16 or 18 in cervical neoplasia in Guadeloupe. BMC Cancer, 2021; 21: 281.
8. Viveros-Carreño D, Fernandes A, Pareja R. Updates on cervical cancer prevention. Int J Gynecol Cancer, 2023; 33: 394–402.
9. Dicu-Andreescu IG, Marincaș AM, Ungureanu VG, Ionescu SO, Prunoiu VM, Brătucu E, Simion L. Current Therapeutic Approaches in Cervical Cancer Based on the Stage of the Disease: Is There Room for Improvement? Medicina (Kaunas), Jun. 30, 2023; 59(7): 1229.
10. Tumors of the cervix. In: Morrow CP, Curtin JP: Synopsis of Gynecologic Oncology. 5th ed. Churchill Livingstone, 1998; 107-151.