

# Application of artificial intelligence and big data analysis in diagnosis and analysis of gynecological cancer

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**Abstract:** Artificial intelligence (AI) is a new technology science for simulating, extending and expanding human intelligence. It is a comprehensive interdisciplinary frontier discipline developed on the basis of computer science, cybernetics, information theory, neuropsychology, philosophy, linguistics and other disciplines, It is also a large and complex data set or big data [2]. The concept of AI was put forward as early as 1965, but no breakthrough has been made. With the rapid development of big data, algorithm and computing power, AI technology has made revolutionary progress [3]. In 2016, alphago of Google successfully defeated the world go champion, making AI quickly enter the public view. Big data and AI complement each other. Medical big data can find out the medical information to be explored and used through AI, and generate new data, which helps medical workers to understand more objectively

And master the development law of various diseases, and even re understand the evolution mechanism of some diseases. It can be applied to medical imaging, drug mining, hospital management, wearable equipment, pathological diagnosis, virtual assistant, clinical diagnosis and treatment and other medical fields [4]. AI and big data have broad prospects for research and application in the field of gynecological cancer, mainly including disease early warning, diagnosis and treatment, intelligent health management, gene detection and drug research and development. This paper summarizes the following aspects.

## 1. Early warning

Early prevention of gynecological cancer is conducive to reduce the prevalence and improve the survival rate of patients. Therefore, early warning is the focus of prevention and treatment of gynecological cancer. However, at present, there is no specific early warning system and standard. It is very important for AI to establish an early warning model in the field of gynecological cancer [5], which can find the correlation between the test results of patients, the condition and the medical results from big data, Identify high-risk women with invasive cancer and pre-invasive diseases with real pre cancer potential, and refer them, strengthen monitoring or individualized intervention treatment in advance. Some studies have shown that the accuracy rate of using artificial neural network technology to predict endometrial cancer in 178 women with endometrial thickness of 5mm and postmenopausal vaginal bleeding is as high as 85.4% [6]. Another large-scale prospective multicenter study uses advanced neural network and AI technology to develop clinical decision support scoring system (DSSS), using the ability of all biomarker information to accurately predict which women have clinically significant lesions with real carcinogenic potential (Cin2 or worse), and gives quantitative probability of different histological diagnosis [7]. The introduction of AI provides a new statistical explanation. It can provide clinicians with useful early warning tools in primary care of gynecological cancer. But it needs to be explored in the future.

## 2. Auxiliary intelligent diagnosis and treatment

### 2.1 Provide treatment plan

Provide treatment plan AI to constantly improve itself by learning professional medical

knowledge, use cognitive analysis technology, search massive big data, simulate doctors' thinking and diagnosis reasoning, give opinions quickly, assist doctors to make diagnosis and treatment decisions, and monitor treatment. IBM Watson in the United States is a relatively mature case. Watson for Oncology (WFO) is currently used in ovarian cancer, cervical cancer, endometrial cancer, etc. its database includes more than 300 medical journals, more than 200 textbooks, 15 million cancer related academic papers and research data, as well as the clinical guidelines regularly updated and published by NCCN; In addition, 3469 medical monographs, 248000 papers, 69 treatment plans, 61540 experimental data and 106000 clinical reports can be read in 17s. Watson's cancer treatment plan is consistent with that of top experts by more than 90%

## **2.2 Image diagnostic**

Ultrasound, magnetic resonance, computed tomography, colposcopy, hysteroscopy and other imaging technologies have become an important means of screening, diagnosis, staging, efficacy evaluation, treatment and follow-up of gynecological cancer. Image diagnosis depends on the personal clinical experience of doctors, which is easy to cause misdiagnosis and missed diagnosis. With the increasing workload and the imminent shortage of doctors, AI seems to be a logical alternative. AI can reduce the bias of observers, reduce the heavy work of doctors, make them more focused on difficult cases, help to identify rare diseases and standardize the quality of reports. AI reconstructed and analyzed the image data structurally, extracted the key features of the lesion, established the training and recognition model of computer vision, and then obtained the disease analysis report and auxiliary diagnosis scheme. AI image diagnosis has made great achievements in MRI diagnosis of Alzheimer's disease, CT diagnosis of small pulmonary nodules, molybdenum target diagnosis of breast cancer, and some of the diagnostic rates have exceeded that of human experts. AI technology can capture the micro texture features in the images, classify and predict the colposcopy images, and predict whether there is microvascular and nerve invasion, lymph node metastasis, etc. according to the images before operation, and then guide the individualized treatment, and further use the advantages of large data can help to identify the benign and malignant of the occupied uterus and accessories, and diagnose rare gynecological cancer, So as to guide clinical diagnosis and treatment.

## **2.3 Pathological diagnosis and pathology is the gold standard of cancer diagnosis.**

With the rapid development of AI technology in image recognition, natural language extraction and other aspects, automatic histopathological image analysis has become an important research issue of pathological diagnosis, which has been widely used in the differential diagnosis, disease classification, classification and prognosis judgment of breast cancer, gastric cancer and other cancers. There are similar researches in the field of gynecological cancer. Cervical liquid based cytology is a very effective cancer detection tool based on cell imaging, which can divide cervical cell images into normal, low-grade squamous intraepithelial lesions (LSIL) and high-grade squamous intraepithelial lesions (HSIL). The world's first cervical cancer diagnosis robot "randing" developed by sun Xiaorong medical laboratory competed with five famous domestic experts for cervical cancer diagnosis within 20 minutes, and its 7 diagnostic results were completely consistent with those of experts; the upper limit of manual screening based on microscope was increased from 100 cases / person per day to 30000 cases / person per day, and the efficiency of cervical cancer screening was increased by 300 times, The workload of doctors' diagnosis was reduced to 15%. At the same time, the cloud diagnosis platform is built in combination with the Internet,

Remote consultation with pathologists can avoid waiting time in hospital. The whole process of AI diagnosis does not need manual analysis, only the doctors need to review the results, which not only greatly improves the efficiency of disease screening, but also overcomes the errors caused by the strong subjectivity of artificial diagnosis, and improves the accuracy of doctors' diagnosis.

In addition, AI technology has high accuracy, which can extract some features that cannot be recognized or quantified by the naked eye, so as to make early diagnosis, such as distinguishing cervical epithelial cells from normal, cin1, Cin2, and CIN3 [19-20] by key features of cervical epithelial cell nucleus or artificial marker nuclear images of biomarkers (p16 positive, Ki-67

positive, p16 and Ki-67 positive, p16 and Ki-67 negative).

## **2.4 Treatment**

### **2.4.1 The operation treatment AI creates**

The virtual operation site image, carries on the AI image analysis and the depth processing, establishes the pre operation plan and the surgery step simulation and so on pre operation fine plan, the surgery navigation cooperation, the cancer ablation, the implementation surgery and so on basic operation. Robot assisted surgery has become the most advanced minimally invasive surgery method for gynecological cancer. The most typical is the Da Vinci robot, which is mainly composed of the operating table of the surgeon, mobile manipulator and three-dimensional imaging system. It has three-dimensional imaging, high-definition and vertical vision with 10-15 times magnification, intuitive movement control and turning arm, which makes the operation in the abdominal cavity more sensitive, At the same time, it can filter the surgical tremor and make the operation more stable and safe. Compared with the traditional laparoscopic and open surgery, it has the advantages of less bleeding, wide range of activity and operation, less postoperative complications, less postoperative pain relief, more number of lymph nodes to be cleaned, and more advantages for early ovarian cancer patients with fertility preservation. In addition, with the help of the Internet and the screen, the mechanical arm can be remotely controlled to complete the operation and realize telemedicine.

### **2.4.2 Chemotherapy**

Cancer cells can produce multiple drug resistance, in part because the concentration of chemotherapy drugs through blood circulation to cancer is lower than the concentration required for treatment AI technology is expected to reduce the drug resistance of chemotherapy drugs. First, AI can predict the most effective anticancer drugs and their reactions, and keep the constant release of drugs to make the concentration level higher than a certain threshold. Secondly, more and more work shows that the functional combination of drugs and nano robots can quickly and accurately lock cancer cells and specifically combine them, greatly enhance the treatment effect, greatly reduce the drug dose and side effects, mainly used for targeted treatment of gynecological cancer in vivo. Ovarian cancer is often accompanied by widespread intraperitoneal dissemination and implantation. Intraperitoneal perfusion chemotherapy is a way to improve the anti-tumor effect. However, it has a key disadvantage of poor drug penetration. A computer model has been developed to rapidly transport and infiltrate cisplatin and paclitaxel in the covered nodules of ovarian cancer by magnetic delivery nanoparticles, The spatial heterogeneity of cancer characteristics (such as vascular distribution, hydrophilicity, etc.) is incorporated into the computer model to simulate the spatial dynamics of drugs, which greatly enhances the ability of anti-cancer drugs to penetrate into the cancer treatment center area, rather than being limited to the surface local cancer [2]

### **2.4.3 Radiotherapy**

External radiation therapy (EBRT) and intraluminal brachytherapy are recommended for patients with locally advanced stage I b2-iv cervical cancer

Distance radiotherapy requires accurate targeted and accurate dose delivery. Any unexpected deviation of the set target movement may lead to the exposure of key structures without or without exposure to the target dose. It seriously affects the treatment effect of the disease, and even leads to serious side effects. Therefore, accurate delineation of the total tumor target area, clinical target area and organs at risk is a prerequisite for its planning and implementation. Manual delineation is a time-consuming and labor-consuming process to develop accurate and efficient automatic demarcation AI with optimized three-dimensional space, which will improve clinical practice of radiation oncology. By using AI methods such as deep learning, the correlation model of individual characteristics and dosimetric characteristics of patients is established, the target dose is predicted automatically, and the automatic design of radiotherapy plan is realized. For example, the eclipse treatment planning software of Varian Medical system can realize the intelligent design and dose

optimization of radiotherapy plan dose. At present, AI technology such as machine learning or deep convolution neural network is still in the research stage for radiotherapy. It needs a certain number of expert segmentation image training to meet the ideal requirements of professional radiologists. The more data, the smaller the volume range error. The establishment of a new radiotherapy model based on big data and AI can help doctors standardize radiotherapy, provide precise radiotherapy, and contribute to individualized, safe and effective radiotherapy.

#### **2.4.4 Immunotherapy**

In recent years, the application of immunotherapy in gynecological malignant tumors has attracted more and more attention of researchers. At present, programmed cell death-1 and programmed cell death ligand-1 (PD-1 / PD-L1) blocking has become an important way of immunotherapy to benefit patients with advanced recurrent cervical cancer or Nestle cancer. By detecting the high expression of PD-L1 in the residual drug-resistant tumor after neoadjuvant chemotherapy for advanced serous ovarian cancer, we can guide patients to choose follow-up immunotherapy [31]. AI technology can analyze the genes of CD8 + T cells with reduced function induced by loss of function. The combination of AI and genes is the development trend of immunotherapy in the future. It can integrate multi parameter information, reveal tumor characteristics and provide hints for treatment decisions

### **3. Intelligent health management**

Intelligent health management is to use data integration, analysis and evaluation of the overall status of patients, identify the risk of tumor recurrence as early as possible and provide personalized management intervention programs and follow-up medical services. Nearly one third of patients with cervical cancer die within five years after diagnosis. AI technology can predict the length of life of cancer patients; Obrzut et al [33] found that probabilistic neural network (PNN) is an effective tool to predict the 5-year overall survival rate of patients with cervical cancer after radical hysterectomy. In addition, the detection of circulating tumor cells (CTC) has been proved to be able to predict the efficacy, metastasis and recurrence of ovarian cancer patients. Intelligent health management platform is convenient for follow-up and management of cancer patients. It can evaluate the treatment and survival impact of cancer patients, and provide scientific basis for health administrative departments to formulate relevant policies.

### **4. Gene detection and drug development**

In the in-depth study of gynecological cancer, medical workers have found the problems of drug resistance, cancer genome heterogeneity, cancer recurrence and combination of drugs, so it is necessary to speed up the listing of new drugs. The key to cancer treatment is to find potential drug targets by analyzing the gap between the corresponding cancer genome information and the metabolic pathway of biomolecules. By building a cancer patient gene database, processing and visualizing the expression of genes, we can realize the organic association between the genome and the disease group of phenotype group, better understand the molecular mechanism of cancer resistance, predict which drugs the tumor may be resistant to, and develop a new generation of anti-cancer drugs that can resist resistance. For example, Hopfield pattern can recognize gene inhibition target to destroy cervical cancer cell cycle. The combination of AI and gene can quickly analyze the preclinical trials of drugs, find out the target drugs, quickly establish the pharmacokinetic model, evaluate the efficacy, predict the adverse reactions, and speed up the clinical trials.

### **5. Summary and Prospect**

The application of AI in the medical field is gradually developing, and the AI model based on big data is gradually established, which will make great contributions to the disease prevention and

control, screening, disease distribution, genetic map, gene detection, human data analysis, diagnosis and treatment of gynecological malignant tumors. Although AI has powerful data and computing ability, it only processes and analyzes the input information according to the program designed by human beings, and lacks the ability of self-awareness, emotion and self reflection of its own situation. Therefore, AI is still immature at present, which needs continuous exploration and progress at the initial stage.

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