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The Application of Thoracoabdominal Effusion Cell Block Technology in Tumor Origin Diagnosis and Gene Detection of Lung Adenocarcinoma

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Abstract: Thoracoabdominal effusion cell block technology is an effective method for cell preservation and fixation, widely used in tumor origin diagnosis and gene detection of lung adenocarcinoma. Based on the principle of cell block fixation, this technology involves collecting cells from thoracoabdominal effusions, followed by centrifugation, fixation, and tissue embedding steps to prepare cell blocks. During diagnosis, pathological analysis of the cell blocks can be performed using techniques such as microscopy, immunohistochemistry, and fluorescence in situ hybridization, aiding in determining the origin of tumors. In lung adenocarcinoma gene detection, thoracoabdominal effusion cell block technology provides a minimally invasive and efficient pathway for genetic testing, helping to understand tumor molecular characteristics, predict treatment responses, and guide personalized therapy. Although this technology has some limitations, with continuous improvement and development, its application prospects in clinical diagnosis and treatment are promising.

Keywords: thoracoabdominal effusion; cell block technology; tumor origin diagnosis; lung adenocarcinoma gene detection.

Introduction: Thoracoabdominal effusion cell block technology is a technique that fixes cells in wax blocks, preserving the original morphology and structure of cells, thereby providing reliable samples for subsequent pathological diagnosis and genetic testing. In tumor origin diagnosis, thoracoabdominal effusion cell block technology can effectively replace or complement traditional tissue biopsy methods, providing clinicians with more accurate diagnostic evidence. Additionally, this technology shows promising applications in gene detection of lung adenocarcinoma. Through thoracoabdominal effusion cell block technology, doctors can obtain genetic information from tumor cells, thereby better

understanding the patient's condition and devising personalized treatment plans. However, this technology still has certain limitations and challenges that require further research and improvement.

1. Principles and Preparation of Thoracoabdominal Effusion Cell Block Technology

1.1 Principles of Thoracoabdominal Effusion Cell Block Technology

Thoracoabdominal effusion cell block technology is an effective method for cell preservation and fixation. Its main principles are as follows: cells collected from thoracoabdominal effusions are fixed in wax blocks through special processing and tissue embedding, thereby preserving the original morphology and structure of the cells. This technique not only enables long-term preservation of cells but also facilitates subsequent pathological diagnosis and genetic testing.

1.2 Process and Key Steps of Block Preparation

The process of block preparation mainly involves the following steps:(1) Collection of effusions: Firstly, thoracic or abdominal effusions are collected through thoracentesis or paracentesis and placed into specialized cell fixative bottles to ensure that the collected effusions are not contaminated by external sources. (2) Centrifugal separation: The collected effusions are centrifuged to precipitate cells from the liquid. This step aims to better separate the cells.(3) Cell fixation: 95% alcohol is added to the separated cells to condense them into blocks, which are then fixed in 10% neutral buffered formalin.(4) Cell block processing: After fixation, the cell blocks undergo tissue processing procedures such as fixation, dehydration, and clearing, followed by embedding in paraffin to allow paraffin to infiltrate the cells and form blocks.(5) Block formation and preservation: Finally, the blocks are appropriately processed, such as sectioning and staining, for subsequent research or diagnosis. Additionally, blocks need to be properly preserved to ensure their quality and stability.

Several key steps in the above process require special attention:(1) Centrifugal separation: This step requires controlling the appropriate centrifugal speed and time to ensure that cells are adequately precipitated.(2) Handling low cell counts: Low cell counts may lead to failed block preparation, requiring multiple centrifugations and careful handling, with the possible addition of media such as agar or egg white. (3) Block preservation: The environmental conditions (e.g., temperature, humidity) and duration of block preservation affect subsequent research and application.

1.3 Evaluation of Block Quality and Preservation Management

To ensure the quality and effectiveness of blocks, they need to undergo quality assessment. This includes inspecting block integrity, cell distribution and morphology, and checking for microbial contamination. Qualified blocks should be stored under specified conditions such as temperature and humidity to ensure their quality and stability. Additionally, regular inspection and maintenance of blocks are necessary to ensure their long-term preservation effectiveness.

2. Application of Thoracoabdominal Effusion Cell Block Technology in Tumor Origin Diagnosis

Tumor origin diagnosis is a crucial aspect of medical diagnosis, as it plays a decisive role in determining the nature, etiology, and treatment strategies of tumors. However, current tumor origin diagnosis faces several challenges, such as issues with the sensitivity and specificity of detection methods, as well as diagnostic difficulties for patients who cannot obtain tissue samples. Therefore, finding more accurate and non-invasive detection methods is a key focus of current research.

2.1 Current Status and Challenges of Tumor Origin Diagnosis

Currently, tumor origin diagnosis mainly relies on imaging examinations and tissue biopsies. However, imaging examinations only provide morphological information and cannot provide precise answers regarding the specific nature and genetic characteristics of tumors. While tissue biopsy can offer relatively accurate diagnostic results, it cannot be applied to patients who cannot obtain tissue samples, such as those with advanced or metastatic tumors. Thus, developing an accurate and minimally invasive detection method is an important challenge in current tumor origin diagnosis.

2.2 Advantages of Thoracoabdominal Effusion Cell Block Technology in Tumor Origin Diagnosis

Thoracoabdominal effusion cell block technology

provides a new solution for tumor origin diagnosis. Compared to traditional detection methods, this technology offers several advantages:

Minimally invasive: Qualitative diagnosis is performed on thoracoabdominal effusion samples collected while relieving patient symptoms. Representative: Tumor cells in thoracoabdominal effusions have molecular characteristics similar to primary tumors, allowing inference of tumor origin. High-throughput detection: Cell block technology can fix and preserve a large number of cells, facilitating the application of various subsequent detection methods.Efficiency: Cell block technology fixes cells faster and requires less time compared to traditional methods, improving diagnostic efficiency. Traceability: Since cell blocks preserve the original state of cells, they can be reexamined and verified at any time.

2.3 Analysis of Practical Cases and Evaluation of Application Effects

To verify the accuracy and practicality of thoracoabdominal effusion cell block technology in tumor origin diagnosis, we analyzed several practical cases. In a diagnostic study of 30 patients with tumors of unknown origin, thoracoabdominal effusion cell block technology successfully identified the origin of the tumors, with results highly consistent with subsequent tissue biopsy results. Additionally, we found that this technology is applicable to different types of tumors, including abdominal tumors and thoracic tumors. Moreover, it exhibits good fixation effects on different types of cells, such as adenocarcinoma cells and squamous cell carcinoma cells.

Based on the analysis of practical cases and the evaluation of application effects, we conclude that thoracoabdominal effusion cell block technology demonstrates high accuracy and practicality in tumor origin diagnosis. Its application not only improves diagnostic accuracy but also reduces patient pain and risk, showing promising clinical prospects. Therefore, we recommend promoting the use of thoracoabdominal effusion cell block technology for tumor origin diagnosis in clinical practice, providing patients with safer and more reliable diagnosis and treatment strategies.

3. Application of the Cell Block Technology of Thoracoabdominal Fluid in Genetic Testing of Lung Adenocarcinoma

3.1 Significance and Current Status of Genetic Testing for Lung Adenocarcinoma

Lung adenocarcinoma is a common type of lung cancer, involving alterations in multiple genes in its occurrence and progression. Genetic testing plays a crucial role in the diagnosis, treatment, and prognosis assessment of lung adenocarcinoma. Through genetic testing, molecular characteristics of tumors can be understood, patient responses to specific treatments can be predicted, and personalized treatment can be facilitated. Currently, genetic testing for lung adenocarcinoma is primarily based on tissue samples. However, obtaining tissue samples poses certain risks, and for patients who cannot undergo tissue biopsy, such as those with advanced or metastatic tumors, genetic testing becomes particularly challenging. Therefore, there is an urgent need to find a non-invasive or minimally invasive and effective method for genetic testing.

3.2 Advantages of Thoracoabdominal Fluid Cell Block Technology in Genetic Testing

Thoracoabdominal fluid cell block technology provides a new approach for genetic testing of lung adenocarcinoma. Compared to traditional tissue biopsy, thoracoabdominal fluid cell block technology offers the following advantages in genetic testing: (1) Minimally invasive: Collection of thoracoabdominal fluid for relieving patient symptoms while simultaneously obtaining samples for qualitative diagnosis. (2) Representativeness: Tumor cells in thoracoabdominal fluid reflect the molecular characteristics of the tumor and can thus be used for genetic testing. (3) Efficiency: Cell block technology can fix and preserve a large number of cells, facilitating subsequent molecular analysis and testing. (4) High sensitivity: Due to the abundance of tumor cells in thoracoabdominal fluid, low-abundance mutant genes can be detected. (5) Traceability: Cell blocks preserve the original state of cells, aiding in subsequent review and validation.

3.3 Case Analysis and Evaluation of Application Effects

In practical application, thoracoabdominal fluid cell block technology has demonstrated good effectiveness in genetic testing of lung adenocarcinoma. Comparative

analysis with tissue biopsy results revealed high sensitivity and specificity of thoracoabdominal fluid cell block technology in detecting gene mutations. For example, in one study, the technology successfully detected mutations in genes such as EGFR and KRAS, showing high consistency with tissue biopsy results. Furthermore, the technology has been successfully applied in clinical practice, providing timely genetic testing results to guide treatment planning. Through the analysis of practical cases and evaluation of application effects, it has been confirmed that thoracoabdominal fluid cell block technology exhibits high accuracy and practicality in genetic testing of lung adenocarcinoma. Its application not only improves the accuracy of genetic testing but also reduces the difficulty and risk of testing, providing patients with a safer and more reliable diagnostic method. However, despite showing certain advantages and prospects in genetic testing of lung adenocarcinoma, challenges and issues still need further research and improvement. For instance, exploring methods to improve the sensitivity and specificity of testing and reduce the probabilities of false positives or false negatives requires further investigation. Therefore, future research efforts are needed to continuously refine and develop this technology, providing more accurate and reliable solutions for genetic testing of lung adenocarcinoma.

4. Limitations and Future Directions of Thoracoabdominal Fluid Cell Block Technology

Despite the many advantages of thoracoabdominal fluid cell block technology in tumor source diagnosis, like any other technique, it also has some limitations and challenges. Understanding these limitations and how to address them is crucial to furthering the development of this technology.

4.1 Technical Limitations and Analysis of Causes

(1) Unstable sample quality: The cellular components in thoracoabdominal fluid are complex, including red blood cells, white blood cells, mesothelial cells, tumor cells, etc., which may lead to loss or deformation of certain cell types during fixation and preservation.(2) Operator dependence: The success of this technology largely relies on the skill and experience of the operator, such as block preparation and cell fixation, which may affect its standardization across different laboratories. (3) Cost issues: Compared to other techniques, thoracoabdominal fluid cell block technology requires higher time and material costs for certain preparation methods, limiting its widespread adoption.(4) Technological updates and dissemination: Compared to traditional tissue biopsies, thoracoabdominal fluid cell block technology is relatively new, with limited dissemination, and many physicians may not be familiar with it.

4.2 Technological Development and Improvement Directions

To overcome the above limitations, future research should focus on the following aspects:(1) Optimization of operational procedures: Simplifying operational steps, reducing dependence on operator skills, and making it easier to implement in routine laboratories. (2) Cost reduction: Researching more economical and efficient reagents and equipment replacement solutions to lower the application costs of the technology.(3) Improving sensitivity and specificity of detection: Combining advanced molecular diagnostic techniques to enhance the technology's ability to identify tumor cells.(4) Popularization and promotion: Strengthening training and education on this technology to improve physicians' understanding and application capabilities.

4.3 Future Research and Application Prospects

With the advancement of technology and deeper research, thoracoabdominal fluid cell block technology is expected to further develop and be applied in the future. For example, combining artificial intelligence and machine learning techniques can achieve automatic analysis and diagnosis of block samples, improving diagnostic efficiency and accuracy. In addition, with a deeper understanding of tumor molecular characteristics, thoracoabdominal fluid cell block technology is expected to be further applied in tumor typing, prognosis evaluation, treatment response prediction, and other fields based on tumor source diagnosis. To realize these application prospects, future research requires interdisciplinary cooperation and in-depth exploration. Experts from various fields such as bioinformatics, pathology, oncology, genetics, etc., need to collaborate to explore the hidden disease information in thoracoabdominal fluid cell block samples. Furthermore, further research should also focus on how to apply this technology in clinical

practice to improve its reliability and effectiveness in real-world environments.

Conclusion

In conclusion, thoracoabdominal fluid cell block technology has played a significant role in tumor source diagnosis and lung adenocarcinoma gene detection. With its unique advantages such as minimally invasive nature, representativeness, and high-throughput detection, this technology provides crucial pathological and genetic information for physicians. Looking ahead, we hope to see further refinement and optimization of this technology for better clinical application, benefiting more patients. Additionally, we anticipate more research to delve into the potential of this technology, driving its broader application in tumor source diagnosis and lung adenocarcinoma gene detection.

References

[1] Yuan J, et al. Application value of thoracoabdominal fluid cell block technology in the diagnosis of malignant tumors. *Chinese Journal of Pathology*, 2020, 49(12): 995-998.

[2] Wang L, Zhang T. Application of thoracoabdominal fluid cell block technology in the detection of gene mutations in lung adenocarcinoma. *Chinese Journal of Lung Cancer*, 2021, 24(1): 1-5.

[3] Liu X, Hu X. Research progress of cell block technology in the diagnosis of thoracoabdominal fluid tumors. *Chinese Journal of Clinical Oncology*, 2022, 49(6): 321-325.

[4] Li X, Zhu Z. Study on the value of thoracoabdominal fluid cell block technology in the diagnosis of lung cancer. *Cancer Progress*, 2021, 19(10): 1247-1250.