

The Science Behind Antibody-Drug Conjugates and their Role in Cancer Treatment

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ABOUT THE STUDY

Antibody-Drug Conjugates (ADCs) are an innovative class of cancer treatments that combine the specificity of monoclonal antibodies with the potency of chemotherapy drugs. These biopharmaceuticals are designed to deliver highly targeted therapy directly to cancer cells, minimizing damage to healthy tissues and reducing side effects compared to traditional chemotherapy.

Awareness on ADCs

An ADC consists of three key components:

Monoclonal antibody: This is the "targeting" component of the ADC. It binds specifically to certain antigens (proteins) present on the surface of cancer cells. These antigens are often unique or overexpressed in tumors.

Linker: The linker connects the monoclonal antibody to the cytotoxic drug (chemotherapy). It ensures that the drug stays attached to the antibody until the ADC reaches the cancer cell, preventing the premature release of the drug.

Cytotoxic drug: This is the potent chemotherapy drug that can kill the cancer cells once inside. It is usually too toxic to be used in traditional chemotherapy alone, but when attached to an antibody, it can be delivered directly to the cancer cell, reducing its harmful effects on healthy cells.

Role of ADCs

The effectiveness of ADCs comes from their ability to deliver chemotherapy drugs directly to cancer cells. Here's how the process works:

Targeting cancer cells: The monoclonal antibody recognizes and binds to a specific antigen present on the surface of cancer cells. Once bound, the ADC is internalized into the cancer cell.

Drug release: After the ADC enters the cancer cell, the cytotoxic drug is released, usually through the breakdown of the linker.

The drug then kills the cancer cell by disrupting its internal processes, often causing cell death.

Selective toxicity: Since the drug is delivered directly to the cancer cell, it significantly reduces the side effects seen with traditional chemotherapy, where healthy cells are also exposed to toxic drugs.

Advantages of ADCs

ADCs offer the advantage of delivering potent chemotherapy drugs directly to cancer cells, ensuring targeted treatment with reduced side effects and increased effectiveness compared to traditional chemotherapy.

Targeted delivery: One of the main advantages of ADCs is their ability to deliver drugs directly to the cancer cell, increasing treatment precision and reducing harm to normal, healthy cells.

Increased potency: ADCs use highly potent cytotoxic drugs that can be much more effective at killing cancer cells than traditional chemotherapy agents. By targeting only cancer cells, these drugs are much more powerful and can deliver stronger doses with fewer side effects.

Reduced side effects: Traditional chemotherapy affects both healthy and cancerous cells, leading to side effects like nausea, fatigue and hair loss. ADCs, however, minimize these side effects by targeting only cancer cells, which means less exposure for healthy tissues.

New treatment for hard-to-treat cancers: ADCs are particularly useful for cancers that are difficult to treat with standard chemotherapy, offering a new treatment option for patients with resistant or advanced cancer.

Challenges and Limitations

Despite their potential, ADCs have a few challenges:

Specificity: ADCs are designed to target specific cancer cell markers. If these markers are not present or are present in low amounts, the ADC may not be effective.

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Resistance: Cancer cells can sometimes become resistant to ADCs by altering the target antigen or by developing mechanisms to prevent the drug from entering the cell.

Toxicity: While ADCs are designed to be more targeted, the powerful drugs they carry can still be toxic to surrounding tissues, especially if the drug is released prematurely.

Cost: ADCs are expensive to develop and manufacture, which can make them costly for patients. This high cost can limit their accessibility, especially in low-resource settings.

ADCs are an exciting and potential cancer treatment. By combining the specificity of antibodies with the cytotoxic power of chemotherapy drugs, ADCs can deliver targeted therapy with fewer side effects. While challenges such as specificity, resistance and cost remain, ADCs show great potential in improving cancer treatment, especially for cancers that are resistant to traditional therapies.