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Another starving approach focuses on amino acid deprivation since certain types of cancer cells are highly dependent on specific amino acids for survival. For example, certain leukemias are dependent on asparagine or arginine for growth. By targeting these amino acids, e.g., by using enzymes like L-asparaginase to deplete asparagine, one has managed to starve cancer cells selectively. Enzyme-based therapies, such as L-asparaginase, have been used in the treatment of acute lymphoblastic leukemia and have demonstrated that depriving cancer cells of certain amino acids can be an effective therapeutic strategy. Cancer cells also rely on lipids for energy and membrane synthesis. Some research focuses on inhibiting lipid metabolism to block cancer cell growth and proliferation. Drugs targeting fatty acid synthesis and oxidation are in development and preclinical testing showing promise in disrupting cancer cell metabolism. Cancer cells sometimes rely also on autophagy, which allows them to break down and recycle components when under stress, including during nutrient deprivation. Inhibitors of autophagy, like chloroquine and hydroxychloroquine have been tested in combination with chemotherapy showing an increased sensitivity of cancer cells to treatment. Concluding on can say that there is some evidence from experiments, particularly in animal models and cell cultures, that starving cancer cells can hinder their growth or kill them, this approach is still in the experimental stages for most cancers, and clinical success has been limited to specific contexts like amino acid deprivation in leukemia.

Facts about polyethylene oxide

The most used DRP is polyethylene oxide (PEO) also known as polyethylene glycol (PEG) in low molecular weight form. PEO and PEG are chemically identical, but differ in molecular weight. The chemical structure of both consists of repeating units of the monomer ethylene oxide ($-CH_2CH_2O-$). The term PEG is used for polymers with a molecular weight below 20,000 g/Mol (or Da). The term PEO refers to polymers with a molecular weight above 20,000 Da up to thousands to millions Da. Typical applications of both polymers differ, therefore. PEG is used in pharmaceuticals, cosmetics, food, and as a laxative. It is soluble in water and various organic solvents. PEO is used due to its higher viscosity as a thickening agent, in lubrication, drug delivery, and water treatment. The use of both is well-established due to its versatile properties such as solubility in water, non-toxicity, and biocompatibility.

The key reasons for adding PEO/PEG to foods and drugs are:

Stabilizer and Thickener:

In foods PEO/PEG can help stabilize the texture of food products, preventing separation of ingredients (e.g., water and oil). It acts as a thickening agent, improving the viscosity of liquids or semi-liquids, ensuring consistent mouthfeel and appearance.

In drugs PEO/PEG stabilizes the active ingredients in liquid formulations, ensuring uniform distribution and preventing the drug from settling or separating over time.

Moisture Retention and Humectant

In foods PEO/PEG can be used to retain moisture in food products, preventing them from drying out during storage. This is important in items like baked goods, candies, or processed meats, where moisture content is critical for texture and shelf life.

In drugs it can be used to prevent moisture loss in tablets or capsules, ensuring they don't become brittle or degrade during storage.

Solvent and Binder

In foods PEO/PEG is sometimes used to improve the solubility of food ingredients, allowing them to dissolve or blend more easily in liquid formulations. In drugs it acts as a binder in tablets and capsules, ensuring the ingredients stick together and maintain a stable form. PEG also aids in dissolving poorly soluble active pharmaceutical ingredients, enhancing drug absorption.

Laxative Effects

In drugs PEG is widely used in over-the-counter laxatives (e.g., Miralax). It works by drawing water into the colon, softening stools, and helping relieve constipation. Its osmotic properties make it an effective treatment for short-term bowel irregularities.

Lubricant

In drugs PEG is commonly used as a lubricant in the manufacturing of tablets and capsules, ensuring that the pills don't stick to machinery during production. It also makes swallowing easier for consumers by providing a smooth coating.

Plasticizer

In foods: In certain food coatings or films (e.g., for candies, some packaged goods), PEO/PEG helps make the material more flexible and less prone to cracking. In drugs: PEG can make drug coatings more flexible and durable, protecting the integrity of the active ingredients and ensuring proper release in the body.

Extended Shelf Life

In foods and drugs: PEG's stabilizing and moisture-retaining properties help extend the shelf life of products, keeping them fresh or effective for longer periods. It also

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helps protect drugs from environmental factors like humidity, which can degrade active ingredients.

Inert and Safe Profile

PEO/PEG is considered to have a low toxicity profile and is generally recognized as safe by regulatory agencies like the FDA. This makes it an attractive choice for use in a wide variety of consumer products. It doesn't react with most active ingredients and remains chemically stable in different formulations. Common food products containing PEO/PEG are processed foods (candy, baked goods), beverages, ice cream, and various packaged items. PEO/PEG containing drugs are laxatives, ointments, creams, capsules, and tablet formulations. In summary, PEO/PEG is added to food and drug preparations for its stabilizing, moisture-retaining, and binding properties, as well as its versatility as a solvent and lubricant. Its safety, stability, and functionality make it widely useful across different industries. However, there are some potential risks associated with its use, particularly in food and drug preparations.

Examples of risks are:

Allergic Reactions and Sensitivity

In drug formulations, PEG can occasionally trigger immune responses or hypersensitivity reactions, including skin rashes or more severe anaphylactic reactions in susceptible individuals. Allergies to PEG in medications are generally uncommon.

Toxicity at High Doses: While PEO/PEG is generally considered non-toxic at low levels, when used in high doses, PEG can cause gastrointestinal distress, including nausea, vomiting, or diarrhea.

Contamination with Impurities: One concern is the potential contamination of PEO/PEG with harmful impurities during the manufacturing process. Ethylene oxide, a precursor to PEO, is a known carcinogen, and if residual ethylene oxide is present in PEO/PEG products, it could pose a health risk. Another contaminant of concern is 1,4-dioxane, which can form during PEG synthesis. 1,4-dioxane is classified as a probable human carcinogen, therefore regulations limit its presence in food and pharmaceuticals to very low levels.

Impact on Drug Bioavailability: In pharmaceuticals, PEG is used as a carrier or excipient to improve drug solubility and stability. However, in some cases, PEG can alter the pharmacokinetics of drugs. Prolonged use of PEGylated drugs may result in the accumulation of PEG in tissues, potentially impacting long-term safety.

PEGylation (the attachment of PEG chains to drugs): It reduces the body's immune response to some drugs, which might be beneficial for certain treatments, however, it may also decrease the efficacy of certain drugs by modifying their absorption and clearance.

Environmental Concerns: PEG is not easily biodegradable. Its widespread use in consumer products has raised concerns about environmental persistence and potential ecological impacts, especially if it enters water supplies. Due to the extremely low concentration of the proposed systemic administration environmental concerns can be omitted.

Regulatory Status: Due to the concerns mentioned, regulatory agencies like the FDA and EFSA (European Food Safety Authority) generally consider PEG/PEO safe for use in pharmaceuticals and food products only within certain concentration limits. There are established guidelines to minimize the risks associated with contamination and toxicity.

Newly detected cancers

In the following the standard treatments for newly detected cancers will be discussed with concern of a possible and suitable combination with simultaneous DRP administration. The standard treatments of newly detected cancers depend on the type, stage, and location of the cancer, as well as the overall health of the patient. Typical treatments are surgery, radiation therapy, chemotherapy, targeted therapy, immunotherapy, hormone therapy, and combinations of these methods.

Surgery

Surgery is often the first treatment for early detected cancers that are localized to a specific area. Surgery may involve tumor resection, part of an organ, or sometimes the entire organ, e.g., mastectomy for breast cancer, prostatectomy for prostate cancer. Surgery is most effective when the cancer has not yet metastasized. It is often combined with other treatments like radiotherapy and chemotherapy to reduce the risk of recurrence.

Radiation Therapy

Radiation therapy uses high-energy rays (like X-rays) to kill cancer cells or shrink tumors. The most common form is external beam radiation, where a machine directs radiation at the cancer. When applying internal radiation (Brachytherapy) radioactive materials are placed inside the body near the cancer site. It can be used as a primary treatment for some cancers (e.g., prostate cancer), before or after surgery to shrink or eliminate remaining cancer cells, or in conjunction with chemotherapy. A simultaneous systemic administration of DRP seems to be possible.

Chemotherapy

Chemotherapy uses drugs to kill rapidly dividing cancer cells throughout the body. Unlike surgery or radiation, which target specific areas, chemotherapy works systemically,

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meaning it can treat cancer that has spread to other parts of the body. It is often used in combination with other treatments to enhance effectiveness. Sometimes, chemotherapy is given before surgery (neoadjuvant chemotherapy) to shrink tumors, or after surgery (adjuvant chemotherapy) to reduce recurrence. The side effects of chemotherapy are that it also affects normal cells, leading to nausea, hair loss, and fatigue. A simultaneous systemic administration of DRP seems to be possible.

Targeted therapies

Targeted therapies focus on specific molecular targets associated with cancer growth, such as proteins or genes involved in cancer cell survival and proliferation. These drugs are designed to attack cancer cells more specifically than chemotherapy, resulting in fewer side effects.

Examples are

Tyrosine kinase inhibitors, used for certain cancers like chronic myeloid leukemia and some lung cancers [36].

Monoclonal antibodies like trastuzumab (Herceptin), target specific cancer cell receptors [37].

Immunotherapy boosts or modifies the body's immune system to recognize and attack cancer cells. Typically, there are so-called checkpoint inhibitors that help the immune system recognize and attack cancer cells. They are used in cancers like melanoma and lung cancer. Immunotherapy can result in long-lasting remission, although not all cancers respond to this treatment.

CAR T-Cell Therapy is a newer form where a patient's T-cells are engineered to better attack cancer cells, e.g., for certain types of lymphoma and leukemia. ("*CAR T Cells: Engineering Patients' Immune Cells to Treat Their Cancers*" was originally published by the National Cancer Institute NIH, 2022*).*

Hormone Therapy: Some cancers, such as breast and prostate cancers, are fueled by hormones like estrogen or testosterone. Hormone therapy works by blocking the body's hormone production or interfering with the hormone's action on cancer cells. Types are *Tamoxifen or Aromatase Inhibitors* for breast cancer, *Androgen Deprivation Therapy* (ADT) for prostate cancer. Hormone therapy is often used in combination with surgery, radiation, or chemotherapy to maximize effectiveness. *

Stem Cell or Bone Marrow Transplant is often used for blood cancers like leukemia and lymphoma. It involves replacing damaged bone marrow with healthy stem cells to help the body produce new blood cells after high doses of chemotherapy or radiation. In *Autologous Transplant*, the patient's own stem cells are harvested and returned. In *Allogeneic Transplant* stem cells come from a donor. (*"Stem Cell Transplants in Cancer Treatment"* was originally published by the National Cancer Institute*, 2023.*

A simultaneous systemic administration of DRP seems in all cases to be possible.

Circulating and metastatic cancer cells

The question is whether CTC and metastatic cancer cells are identical from a structural and/or biological point of view. CTC and metastatic cancer cells share many similarities, but they are not identical in biological or structural terms. CTC have detached from the primary tumor and have the potential to seed new tumors in other parts of the body. CTC undergo changes that help them survive in the hostile environment of the blood. These changes might involve the acquisition of mesenchymal traits (via epithelial-mesenchymal transition, EMT) to increase motility and resist anoikis (cell death due to loss of attachment). Further CTC are highly heterogeneous, i. e., not all CTC have the ability to successfully establish metastatic colonies. Some CTC have stem cell-like properties, which increases their ability to initiate new tumors. CTC may retain characteristics of the primary tumor but may also express additional surface markers or structural changes that help them survive and evade immune detection in the blood. Metastatic cancer cells have successfully extravasated from the bloodstream and adapted to the microenvironment of the distant organ, which is often quite different from the original tumor site. Once metastatic cells invade a new tissue, they may further evolve, selecting traits that allow them to thrive in the new environment. They interact with the surrounding tissue to induce angiogenesis (new blood vessel formation), evade the immune system, and support their growth. Structurally, metastatic cells may differ *more* from primary tumor cells than CTC, having undergone genetic and phenotypic changes that allow them to colonize and grow in new environments. Summarizing the differences, CTC are transitory and mobile, found in circulation, while metastatic cancer cells have already colonized and are growing in a new tissue. CTC must adapt to survive in the bloodstream, whereas metastatic cells adapt to survive and grow in a specific tissue environment. Both types of cells exhibit significant heterogeneity, but metastatic cancer cells tend to undergo further adaptation and evolution once they establish in a distant organ, which may make them more distinct from the original primary tumor cells. Although both types originate from the primary tumor and they share key genetic mutations from the primary tumor, metastatic cells may accumulate more mutations over time.

Do CTC search locations in the circulation with favorable nutrition supply?

Although the process by which CTC spread and form metastasis is not yet fully understood, there is evidence that CTC prefer to settle down sites with favorable nutrient supply and oxygen levels. Important are

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Microenvironmental Factors: Tissues, such as the liver, lungs, and bones, are common sites of metastasis because they provide a favorable environment in terms of nutrients, oxygen, and signaling molecules.

Chemotaxis and Homing: Cancer cells respond to certain signals or chemotactic gradients in the body, such as growth factors, cytokines, or hormones, which can guide them to specific organs or tissues. For example, breast cancer cells often metastasize to the bones because they respond to signals produced by bone cells and the bone microenvironment.

Seed and Soil Hypothesis: This concept, first proposed by Stephen Paget in 1889, suggests that metastasis depends on the interaction between the "seed" (cancer cells) and the "soil" (the microenvironment of a distant organ). Some environments are more favorable for the cancer cells to settle down and grow. Factors such as blood flow, nutrient supply, and local immune responses play a role in determining whether the cancer cells will successfully establish a new tumor.

Metabolic Preferences: Cancer cells often exhibit altered metabolism, favoring high glucose consumption and requiring a substantial energy supply (known as the Warburg effect). It is therefore more probable that they are attracted by areas with enhanced nutrient availability, such as highly vascularized regions of the body.

Vascular Niches: CTC may also lodge in specific vascular niches that provide a supportive environment for their growth. These niches often have enhanced blood supply and specific interactions with the cells lining the blood vessels (endothelial cells) that promote tumor survival.

In summary, while it's not known if cancer cells actively "search" for nutrient-rich locations, they do tend to settle in areas with conditions favorable for their growth, including nutrient supply, oxygen levels, and the other mentioned survival factors.

The assumption that CTC preferentially settle at sites with turbulent blood flow, where there may be enhanced nutrient supply, is still a hypothesis. While blood flow dynamics play a role in the metastasis process, several other factors also influence where CTCs settle and form secondary tumors. Key factors involved in CTC metastasis are:

Blood Flow and Shear Stress: Tumor cells experience varying shear stresses as they travel through the circulatory system. While some studies suggest that CTC may be more likely to extravasate (leave the bloodstream) in areas of disturbed or slow blood flow (such as capillaries or venules), turbulent flow itself is not necessarily a trigger for metastatic settlement. In fact, high shear stress in turbulent flow can damage or destroy tumor cells.

Vascular Structure: Metastasis often occurs in organs with highly vascularized tissue, like the lungs, liver, and bone marrow. These regions may have slower or more irregular blood flow, but nutrient supply is only one part of the equation. The microvascular environment, endothelial cell characteristics, and permeability of the blood vessels in these organs also play important roles in tumor cell settlement [38].

Endothelial Adhesion: CTC must interact with endothelial cells lining the blood vessels to extravasate. Specific molecular interactions (such as the expression of integrins and selectins) between CTC and the endothelium are critical for their ability to adhere to vessel walls and initiate metastasis. Areas of turbulent blood flow may not necessarily enhance these interactions [21].

Pre-metastatic Niche Formation: Metastatic sites are often "primed" by signals from the primary tumor, which can create a favorable microenvironment for CTC to settle. These signals may include secreted factors, extracellular vesicles, or changes in immune cell populations. Nutrient supply at these sites is a contributing factor, but it is not the only one [39].

Mechanical Trapping: CTC can also become mechanically trapped in small capillaries due to their size and reduced deformability, which explains why metastasis is common in organs with dense capillary networks, such as the lungs.

What is important in the context of the present publication is the fact that blood viscosity can change in cancer patients due to several factors related to both the disease and its treatments. These changes are influenced by the type of cancer, its progression, and specific physiological and biochemical changes. Here are some key factors:

Increased Blood Cell Counts (Hyperviscosity Syndrome): Certain blood cancers, like leukemia, lymphoma, and multiple myeloma, can lead to an increase in abnormal blood cells (like white blood cells or plasma cells) or proteins, raising blood viscosity. Multiple myeloma, in particular, can cause hyperviscosity due to excess immunoglobulin proteins in the blood [40].

Changes in Hematocrit Levels: Some cancers or their treatments may increase red blood cell counts, which raises hematocrit levels and thus viscosity. Conversely, anemia (often seen in cancer patients due to blood loss, poor nutrition, or treatment side effects) can lower hematocrit, decreasing blood viscosity [41].

Increased Inflammatory Proteins: Cancer and inflammation often go hand in hand, leading to elevated levels of proteins like fibrinogen. These proteins make blood thicker, contributing to higher viscosity.

Effects of Chemotherapy and Radiation Therapy: Treatments can alter blood cell counts and protein levels,

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either increasing viscosity (due to higher inflammation) or decreasing it (due to anemia or blood loss).

Risk of Blood Clots: Higher blood viscosity in cancer patients can increase the risk of blood clots, particularly in cancers known to cause hypercoagulability (e.g., pancreatic cancer, lung cancer). This effect can contribute to complications like deep vein thrombosis or pulmonary embolism. Monitoring blood viscosity and clotting factors is therefore often part of managing cancer patients, particularly those at high risk for hyperviscosity syndrome or clotting complications.

Blood flow in liver or lungs

The hydrodynamics of blood flow in organs such as the liver and lungs is a key area of study in physiology, biomechanics, and bioengineering. Blood flow dynamics in these organs are highly specialized and essential to their function, both in delivering oxygen and nutrients and in removing waste products. Below is an overview of what is known about hydrodynamics in these two critical organs:

Blood Flow in the Liver (Hepatic Circulation):

The liver has a unique blood supply compared to other organs, characterized by the following features.

Dual Blood Supply: The liver receives blood from two major sources. The hepatic artery supplies oxygenated blood from the heart, accounting for 25% of the liver's blood flow. The portal vein provides nutrient-rich, deoxygenated blood from the gastrointestinal tract, accounting for about 75% of the liver's blood supply (https://www.nottingham.ac.uk/helmopen/rlos/biological-sciences/gastrointestinal-system/liver anatomy/page_two.html).

Sinusoidal Blood Flow: The liver contains small capillary-like vessels known as sinusoids, which have quite different hydrodynamics compared to typical capillaries in other tissues. Sinusoids are wider, allowing slower, lower-pressure blood flow to maximize contact between the blood and hepatocytes (liver cells). The endothelium in the liver sinusoids is fenestrated, i. e., it contains pores, allowing for efficient exchange of materials between blood and liver cells [42].

Flow Dynamics: Blood flow in the liver is relatively slow and exhibits a complex, non-uniform pattern due to the arrangement of sinusoids. This allows for detoxification and metabolism, as well as nutrient storage and distribution. The liver's microvascular flow is influenced by local hemodynamic factors like pressure and shear stress, which can be modulated during liver diseases such as cirrhosis, where increased resistance to blood flow can lead to portal hypertension (https://www.sciencedirect.com/topics/veterinary-science-and-veterinary-medicine/liver-sinusoid.)

Blood Flow in the Lungs (Pulmonary Circulation)

The lungs have a specialized circulatory system adapted for gas exchange. Blood from the right side of the heart is pumped into the pulmonary arteries, which carry deoxygenated blood to the lungs for oxygenation. Oxygenated blood is then returned to the left side of the heart via the pulmonary veins.

Low Pressure, High Flow: The pulmonary circulation operates at much lower pressures compared to systemic circulation. This is crucial because the lungs are delicate structures, and high pressure would damage the alveoli, the tiny air sacs where gas exchange occurs. Despite the lower pressure, the pulmonary circulation has a high flow rate due to the large volume of blood that must be oxygenated rapidly [43].

Alveolar-Capillary Interface: The alveoli are surrounded by a dense network of capillaries. The walls of these capillaries are extremely thin, allowing for efficient diffusion of gases (oxygen and carbon dioxide). Blood flow through these capillaries is optimized to match ventilation, i. e., airflow in the lungs, to ensure effective gas exchange. The matching of ventilation to perfusion is a critical aspect of lung physiology.

Regulation of Flow: The pulmonary circulation can constrict or dilate in response to oxygen levels. In areas of the lung with low oxygen (hypoxia), blood vessels constrict (hypoxic pulmonary vasoconstriction) to direct blood to better-ventilated areas. This mechanism maximizes gas exchange efficiency. Pulmonary blood flow also changes with body posture, exercise, and disease. For example, during exercise, pulmonary capillaries can recruit or distend to accommodate the increased cardiac output without a significant rise in pressure [44].

Key factors in the hydrodynamics of blood flow in both organs are *Vascular Resistance*: Both the liver and lungs regulate blood flow through the dilation and constriction of blood vessels in response to various signals (hormonal, chemical, mechanical).

Pressure Gradients: Blood flow in both organs is driven by pressure gradients. In the liver, the gradient is between the portal vein and hepatic veins, while in the lungs, it is between the pulmonary arteries and veins.

Shear Stress: In both the liver and lungs, shear stress (the force of blood flow against vessel walls) plays an important role in vascular health and function. Changes in shear stress can lead to endothelial cell responses that either protect or harm the vasculature depending on the context.

Pathological conditions in both organs:

Liver: In conditions like cirrhosis, fibrosis of liver tissue increases vascular resistance, leading to portal hypertension, which can disrupt the normal blood flow through the liver.

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Lungs: In diseases like pulmonary hypertension, the pressure in the pulmonary arteries increases, leading to right heart strain and reduced oxygenation efficiency.

In summary, understanding the hydrodynamics of blood flow in the liver and lungs is critical for managing diseases affecting these organs, as abnormal blood flow is a hallmark of many serious conditions such as cirrhosis and pulmonary hypertension.

Preparation of injectable DRP doses

The preparation of injectable DRP doses suitable for cancer treatment consists for example in dissolving PEO of 4000 kDa molecular weight (Sigma-Aldrich, Union Carbide and others) in sterile saline to get a 0.1 % solution. To remove low molecular weight fractions, the solution has then to be dialyzed 24 h against saline by using a 50 kDa cutoff membrane. The PEO solution is finally diluted with saline to 50 ppm and sterilized before injection using a 0.22 µm filter [10,44]. Physiological saline solution (NaCl in a concentration of 0.15 mol/l) is almost identical to plasma. The injected PEO solution degrades mechanically within 2 or 3 days and the fragments are then excreted by the urinary system.

Concluding remarks

Metastatic cancer is responsible for approximately 90% of all cancer deaths. The proposed idea of using DRP in cancer treatment is still a novel and emerging concept, i.e., it has not yet become a standard approach in oncology. DRP have been primarily studied in the context of improving blood flow and reducing resistance in the cardiovascular system. Potential applications in cancer treatment include, for example, the enhancement of drug delivery and circulation. DRP have been studied for their ability to reduce the viscosity of blood and improve microcirculation. This could enhance the delivery of anticancer drugs to tumors, particularly in solid tumors that suffer from poor blood flow. Improved perfusion in tumor areas may allow more effective delivery of chemotherapeutic agents or nanoparticles used in cancer therapy. Tumors often create abnormal blood vessels that hinder effective drug penetration. By reducing blood flow resistance, DRP might be helpful. Another aspect where DRP could be useful is reducing hypoxia in tumors. Hypoxia is a major problem in many solid tumors, leading to resistance to therapies like radiation and chemotherapy. DRP could improve oxygen delivery by enhancing microvascular blood flow, reducing tumor hypoxia, and making tumors more susceptible to treatment. Further, poor circulation due to tumor burden or treatment side effects can complicate therapy. DRP might be used to improve overall blood circulation, thus reducing fatigue. This approach could potentially improve patients' overall condition, allowing them to tolerate more aggressive therapies. Related fields of research are nanomedicine and drug carriers. DRP are widely used in nanomedicine as a component of polyethylene glycol (PEG)-modified nanoparticles and liposomes, which are used to deliver chemotherapy drugs. Further, vascular-targeted therapies to improve blood flow in tumors are ongoing, such as vascular normalization therapies and the use of nitric oxide donors. These strategies, which aim to improve the delivery of therapeutic agents, could potentially also be achieved by DRP. Although the systemic administration of blood soluble DRP in nanomolar concentrations may enhance blood flow and improve drug delivery in cancer treatment, the intravenous injection of DRP is not yet an established cancer treatment either for newly detected cancers or as cancer after care. Apart from further studies in specialized cancer research centers, case studies with small cohorts of patients could also be envisaged. Astonishingly, to the best of our knowledge the promising results of **[10]** have never been repeated or extended to other cancer types.

Developing commercially available injectable DRP solutions would require collaboration with companies that specialize in biomedical polymers, drug formulation, and injectable pharmaceutical delivery. Companies and organizations relevant for this type of development include:

Evonik Industries' healthcare division works with polymers used in drug delivery and provides custom polymer solutions and support for developing injectable formulations.

Croda International's life sciences division focuses on specialty excipients and drug delivery solutions, working with biocompatible and injectable-grade polymers.

Ashland Inc. specialized in pharmaceutical polymers, including injectable grades, and offers custom formulation services.

CSBio and Carbosynth produce specialty biochemicals, including polymers used in drug delivery and research applications. Further, a variety of models is available to study cancer biology, evaluate treatments, and develop new therapies, such as for instance.

Human Cancer Cell Lines derived from human tumors, examples are HeLa, MCF-7 (breast cancer), and A549 (lung cancer).

3D Cell Cultures simulate the tumor environment providing insight into cell-cell and cell-matrix interactions.

Animal Models:

Xenograft Models where human cancer cells are implanted into immunocompromised mice.

Genetically Engineered Mouse Models develop tumors spontaneously in specific organs.

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Patient-Derived Xenografts where human tumor tissue is transplanted into mice.

Humanized Mouse Models with a humanized immune system allow to study immune response to cancer and immunotherapies. Even if the proposed systemic administration of DRP may not totally avoid metastasizing it can reasonably be considered that it would considerably decrease the number of metastasis deaths as leading cause of cancer mortality. To prove the concept the next steps in research should be the reproduction of the cited encouraging results and extending them to other cancer models in order to finally proceed to case studies.

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