Yokoyama“ Nano-medical polymers ” project

Project Leader

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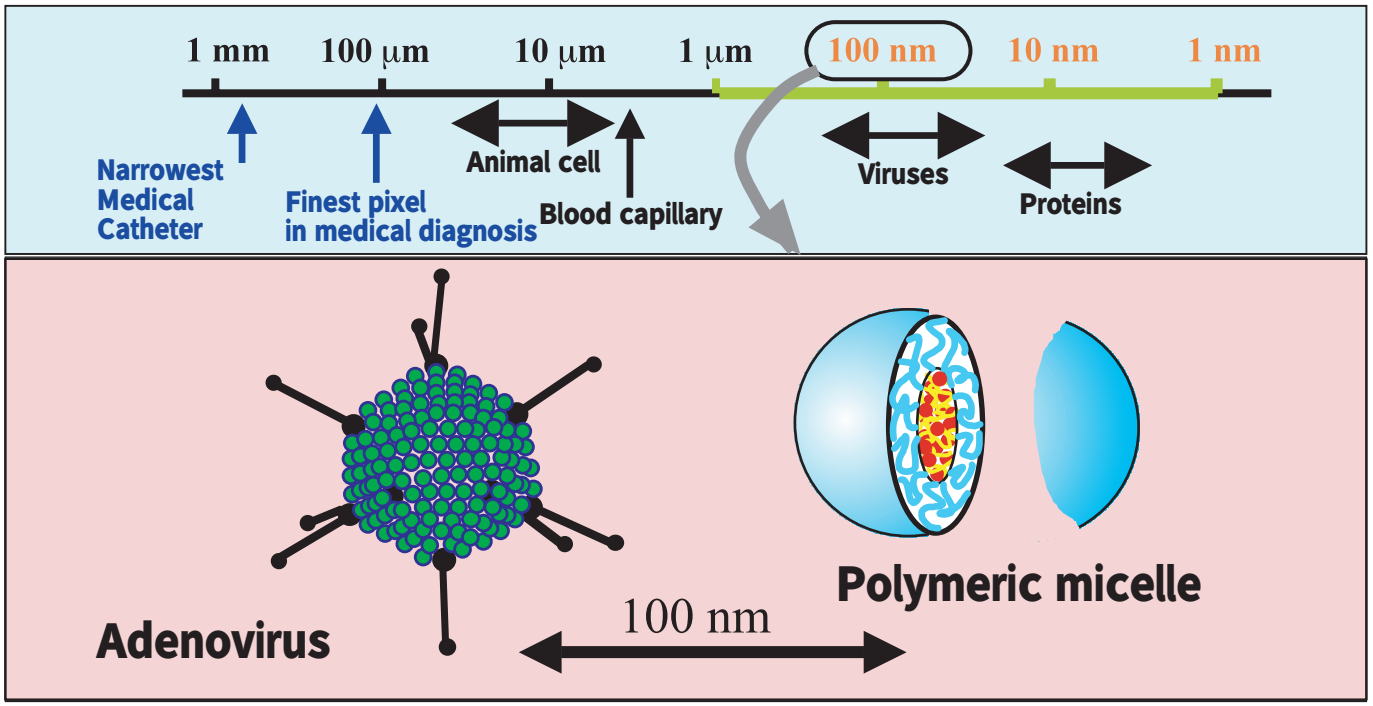
Size range for nano-medicine



In the new millennium, research and development in nanotechnologies have been very active, and medical applications have attracted much attention. Nanotechnologies may be used first for diagnoses using blood or cell samples, but can they also be used for diagnoses and therapies in the body? This project challenges “nanomedicine” in the body using nano-sized polymeric systems, which are much smaller than those used in medical practices at present. One clue toward “nano” medicine is internal transportation in the bloodstream. Proteins cannot be transported from the bloodstream into urine since these macromolecular substances cannot pass through the nano-sized filter in the kidneys. On the other hand, proteins are transported to specific tissues or organs through nano-sized pores in vascular endothelia of these sites. This nano-sized transportation phenomenon may be utilized in drug targeting.

Drug targeting is defined as selective drug delivery to specific physiological sites, organs, tissues or cells where drug pharmacological activities are required. By increasing delivery to the therapeutic sites and reducing delivery to the unwanted sites, therapeutic indices can be improved with enhanced and reduced drug action at the therapeutic and the unwanted sites, respectively. This project will focus on delivering anti-cancer drugs to solid tumor sites whose blood vessels are known to possess many nano-sized pores. The targeting system is polymeric micelles, which are nano-sized assemblies of synthetic polymers. A novel tumor diagnosis system is also being studied by incorporating a MRI contrast agent into polymeric micelles, and the system is expected to greatly contribute to early diagnosis of very small tumors and metastases.

This project will also help establish new medical therapies in the research and development of novel hemostatic agents for surgical operations and anti-virus agents using nano-sized polymeric materials.

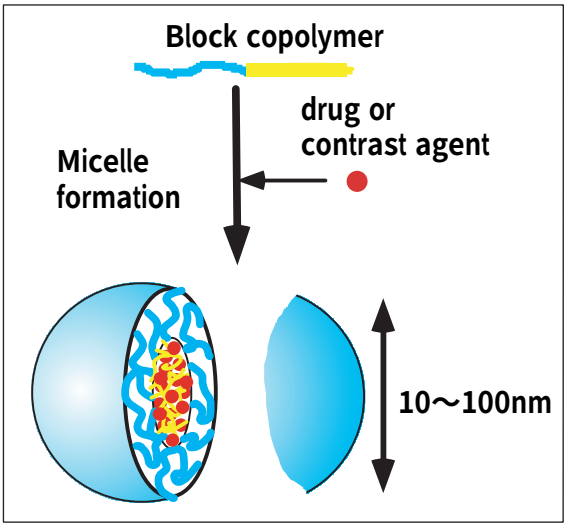


Fig.1 Polymeric micelle carrier system

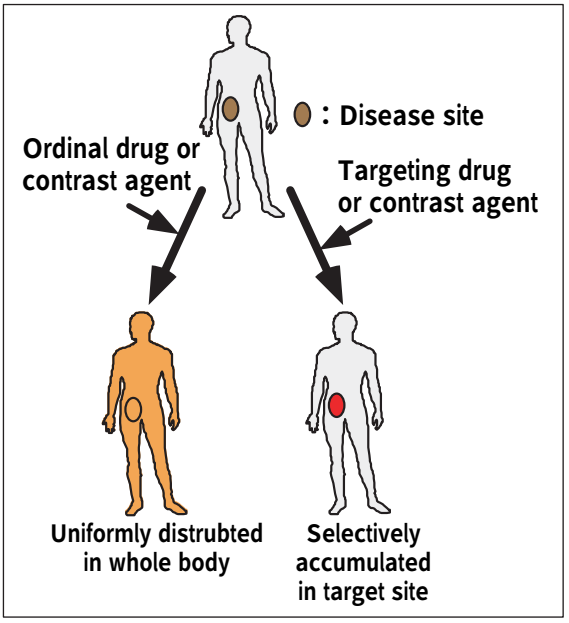


Fig.2 Targeting with polymeric micelle carrier system

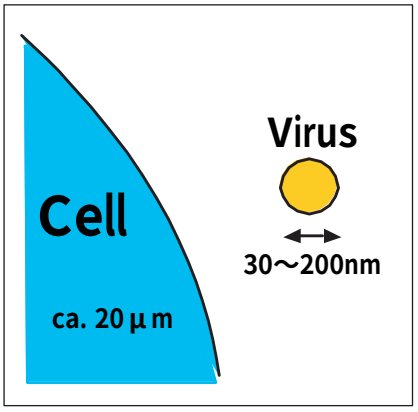


Fig.3 Size of cell and virus.

●Contents of project

1) Targeting of anti-cancer drugs and MRI contrast agents to solid tumors using polymeric micelle carrier system

Chemotherapy using anti-cancer drugs is one of the three major therapies against cancer (the other two are surgical operation and radiation). In the last decade, new anti-cancer drugs with high selectivity between cancer and normal cells have been developed. The cancer/normal cell selectivity, however, is much lower than those obtained for antibiotics against bacterial diseases. This project aims to raise the cancer selectivity by selective delivery of anti-cancer drugs to solid tumor sites using polymeric micelle drug carrier systems. Most of the newly developed anti-cancer drugs are very hydrophobic and water-insoluble. The polymeric micelle systems are advantageous for incorporating these drugs due to their large capacity for incorporating hydrophobic substances. This project also aims to develop a novel MRI contrast agent using the polymeric micelle systems. This novel MRI diagnosis system is expected to contribute to early diagnosis of very small tumors and metastases.

2) Novel hemostatics for surgical operation using polymeric micelles

As surgical techniques rapidly improve, there is a growing demand for effective and safe hemostatics as an alternative method to stop bleeding rather than the conventional suture and needle. A novel hemostatics agent containing polymeric micelles as one component is being studied. This totally synthetic agent is free from the risk of virus or prion infection, and may show excellent hematostatic properties owing to the physicochemical advantages of polymeric micelles

3) Novel anti-virus agent using synthetic polymers

In the history of medicine, many bacteria-infectious diseases have been circumvented with antibiotics. In contrast, very few anti-virus agents are available, and they are not as effective as antibiotics. This project aims to create a new type of anti-virus agent using synthetic polymers. These novel anti-virus agents are based on the large difference in size between virus and human cells. Nano-sized polymers may preferentially interact with small virus particles, and selective breakage or inactivation of the virus particles may be obtained as a result of the preferential interactions.

●Organization of Research

Period: April 2004 to March 2009

Staffs: Project leader, researchers, research fellows from other universities or companies, and secretary

Place: Kanagawa Science Park(KSP), East Building, 4F.