Hypertension
Introduction

Chronic medical condition, in which the blood pressure in the arteries is elevated, is known as Hypertension or High Blood Pressure or Arterial Hypertension.

In normal conditions, blood pressure at rest is within the range of 100-140mm Hg systolic (top reading) and 60-90mm Hg diastolic (bottom reading). If blood pressure is at or above 140/90mm Hg, it is termed as High Blood Pressure. Blood pressure greater than 180/110mm Hg is termed as ‘Hypertensive crisis.’
Nanotechnology Based Hypertension Treatment

**Liposomes**: Liposomes are nanosize artificial vesicles of spherical shape that can be produced from natural phospholipids and cholesterol.
Micelles

Micelles are self-assembled supermolecular structures consisting of amphiphilic macromolecules. When come in contact of water, these amphiphilic assemble to form nanoscopic core-shell structure that can be used as reservoirs for hydrophobic drugs. PEG-based cationic micelles are used for intratracheal gene transfer to the lung of rats with monocrotaline- induced PAH (Pulmonary Arterial Hypertension).
Benefits of Nanoparticle-mediated Drug Delivery

According to a study at National Institute of Pharmaceutical Education and Research, Panjab (India) (Ankola et al) on ‘Development of potent oral nanoparticles formulation of coenzyme Q10 for treatment of hypertension’ indicates the potential of nanobiotechnology in improving the therapeutic value of molecules like CoQ10, facilitating its usage as first line therapeutic agent.

PAH, asthma and COPD share pathological features, so no drug has potential to deal with these. But using nanoparticles of ong VIP analogs, these diseases can be treated.

Study at Kyushu University, Japan (Chen L et al) reveals that by using nanoparticle based drug delivery system, improved survival rate was achieved as compare to control group.
Cardiovascular Diseases
- Affect cardiovascular system, esp. cardiac diseases and vascular diseases of brain and kidney along with peripheral arterial disease.
- Main areas of scope: ischemia, reperfusion-associated conditions, organ undersupply with nutrients and oxygen, acute cardiovascular trauma and wound healing, and atherosclerosis and its hemodynamic consequences.
Diagnostic Applications

- **Molecular imaging of Angiogenesis**: imaging of angiogenic vasculature, monitoring for site-directed delivery and progression of disease.

- **Cellular Imaging**: inorganic fluoropores used for long term tracking of labeled cells, non-toxic.

- **Artificial Molecular Receptors**: replicas of antibodies and cell receptors, in-vivo monitoring of cell-based therapies.

- **Fluid Acceleration Sensors**: Nanoscale micro-electro-mechanical systems (MEMS) have been fabricated for medical and biomedical applications such as pressure and acceleration sensors and devices that dispense drugs and perform analysis on tissue and body fluids.
Therapeutic Applications

➤ **Smart Drugs**: active on certain stimuli, highly sensitive, precise, better delivery rate.

➤ **Nanorobotics**: electro-mechanical devices, inaccessible regions, early diagnosis and better treatment.

➤ **DNA-Based Nanodevices**: engineering DNA to produce nanoscale devices, periodic arrays, and nanomechanical devices, intervene at the cellular level, cytosurgery.

➤ **RESPIROCYTE**: artificial red cell, blood substitution, detecting oxygen content, 200 times more efficient than natural counterparts.
CLOTTocyte: artificial mechanical platelet, clotting starts within 1 sec (1000 times faster), post operative surgery or intra-bleeding.

The cLOTTocyte as it deploys its fibrin meshwork and facilitates wound closure and hemostasis.
Surgical Applications

- **Trauma/Bleeding/Wound Healing in Cardiac Surgery**: clottocytes accelerate the healing process, helps in oxygenation of incised or wounded tissue, nanoparticles and nanospheres which assist angiogenesis also used.

- **Aortic Surgery**: Reduced circulation in brain during surgery, respirocyte used as oxygen-polylic, reduces circulatory standstill time. Cleaning by scavenger nanoparticles.

- **Bioactive Endovascular Stents**: Balloon angioplasty with stent placement is used for cardiovascular occlusive disease, stent resenosis shortens life time of stenting. Polymer coated rapamycin-eluting stents have unofficially reported “zero restenosis”.

Stent-based controlled-release platform. Biodegradable microspheres containing drug or growth factor are loaded onto channeled stents.
Asthma
- Inflammation of airways, causes wheezing, chest tightness, breathing problems and coughing.

- Various types of asthma, major ones are allergic asthma, occupational asthma, atopic asthma.

- Characterised by reversible airway obstruction, bronchial hyperresponsiveness, and chronic inflammation of bronchial mucosa.
Therapeutic application

- **P-selectin**: anti-inflammatory effects.
- **Budesonide nanoparticles agglomerates**: deposits in lungs, allows dissolution and sustainable concentration of drugs.
- **Chitosan/interferon (IFN)-γ pDNA nanoparticles**: production of IFN-γ, target and inhibit inflammatory process in airway.
- **Silver nanoparticles**: cytoprotective activities and pro-healing properties, reduces airway inflammation, hyperreactiveness, reduces reactive oxygen species levels in bronchoaveolar fluid.
Diagnostic application

- **Breath analyser devices**: made using nano-materials is the new generation device for diagnosis of asthma. Nanowires made from pure metal oxide when fabricated by electrospinning are able to select for volatile organic compounds in ppb which can be used as a marker for asthma. The analyzers in use are NIOX Nitric oxide test system and The Sievers Nitric Oxide Analyzer (NOA 280i) which are desktop devices that measure NO concentration from an exhaled sample of human breath.

![Electrospun nanofibrous mat made of polymer-oxide composite](image)

(a) converted to pure oxide nanowires (b) by calcining.
References:

Diabetes


Hypertension


Cardiovascular Diseases

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**Asthma**

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