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REVIEW ON GOLD NANOPARTICLES FOR PHARMACEUTICAL AND BIOMEDICAL INNOVATIONS

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ABSTRACT

gold has traditionally been thought of as a symbol of royalty, and many people have been drawn to it because of its brilliant golden aspect. gold has high molecular recognition abilities, ductility, and biocompatibility. gold is currently employed in numerous industries. gold particles have physical and chemical characteristics that change depending on how many nanometers in size they are. the effects of nanotechnology advancements are especially significant in bio diagnostics, where tests based on nanoparticles have been created for the precise detection of bioanalytes of clinical interest. gold nanoparticles are the perfect candidates for creating biomarker platforms because of their easily controlled physical characteristics, which include distinctive optical features, resilience, and high surface areas recent industrial applications have demonstrated the importance of using metal nanoparticles. currently, physical processes like evaporation are used to create gold nanoparticles. physical methods for producing gold nanoparticles may be replaced by biological processes. targeted pharmaceuticals for photo thermal therapy with reduced harmful effects in different malignancies, gene therapy, and many other disorders. functionalization using a wide spectrum of compounds.

KEYWORDS: Gold Nanoparticles, Cancer treatment, Skin disease, Parkinson's disease and Alzheimer's Disease.

1. INTRODUCTION

nanoparticles are described as particles with a size between 1 and 1000 nm. in nature, there are a wide variety of substances or species that are nanoscale in size. examples include the diameter of the dna double helix, which is about 2 nm, the length of a typical carbon-carbon bond, which is typically between 0. 12 and 0. 15 nm, and the mycoplasma bacterium, which is the tiniest known cellular life form. is approximately 200 mm long.[1] nanoparticles have good cell uptake and in vivo stabilityand are frequently utilised for medication delivery. additionally, metal/metal oxide nanoparticles superoxide disputation is accelerated and antioxidant enzymes are imitated. hydrogen peroxide and ions (2-1). metal/metal oxide nanoparticles deterioration metal ions are released, and inflammation is suppressed.[4]

gold nanoparticles (gnis or aunps) appear to be the most efficient nanoparticles (nps) employed in experimental research, with the least amount of systemic toxicity. Around 2000, a significant number of studies on nanogold were published 15). Gold nanoparticles, nanoclusters, nanocages, nanorods, nanostars, nanoshells, and nanoplates are examples of gold nanomaterials. They hold great promise for biomedical applications due to their controlled geometry, optics, and surface chemistry.[6] Gold also demonstrates unique optical characteristics at the nanoscale level. Gold turns purple at the nanoscale, changing from red. Due to their exceptional qualities, including simplicity of synthesis, controlled size, particular surface plasmon resonance, and good biocompatibility, gold nanoparticles have shown amazing potential for the treatment of a variety of disorders.[7] In order to comprehend the physiological and pharmacological roles of nanogold particles in diverse organ systems and disorders, the content of this review paper is based on the fundamental research conducted on these particles in recent years (Figure 1 and Table 1). This review primarily focuses on the potential for nanogold to treat organ disorders in people. More researchers are anticipated to perform in-depth research in the future in order to incorporate the use of nanogold in treatments for these organ illnesses.

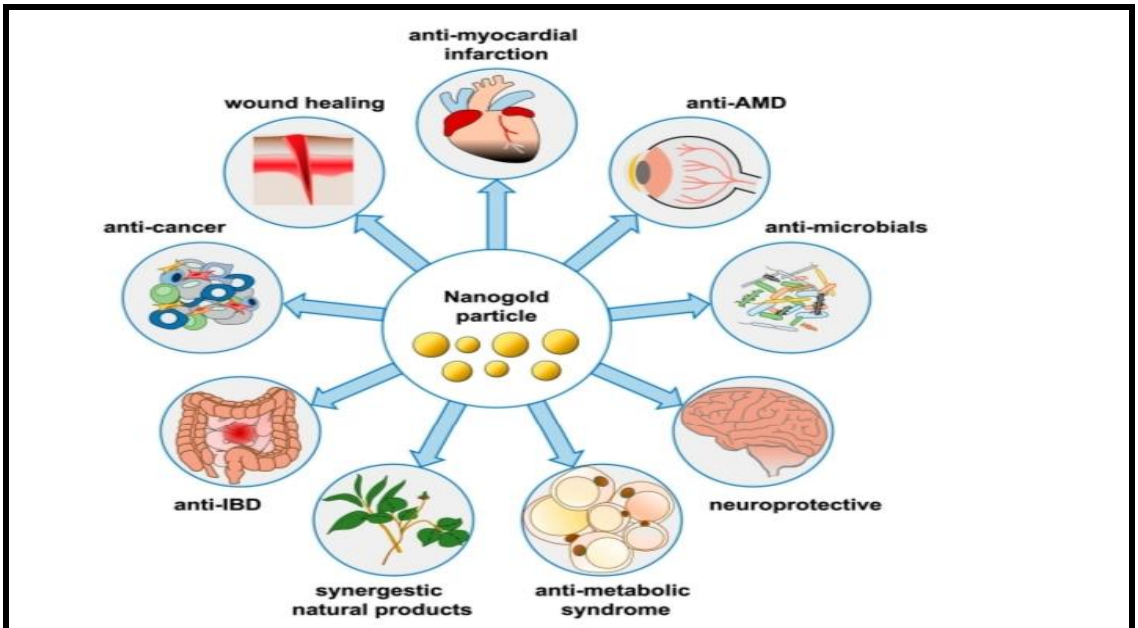

Figure 1. Physiological and pharmacological functions of nanogold in various organ systems

2. Retinopathy

The protective internal and external blood retinal barrier is located in the retina, the eye's innermost layer that covers the rear two-thirds of the eye (BRB). When administered locally or with a specific intraocular injection, nanomaterial's can be created to have qualities and traits that allow them to pass through the BRB.[8] Because of this, ophthalmology has recently given more attention to the use of Nano-grade particles. Age-related macular degeneration (AMD) and diabetic retinopathy (DK) are the two primary retinal disorders that lead to moderate to severe vision impairment globally.[8]

Intravitreal injection of a laser and anti-vascular endothelial growth factor (VEGF) preparations is the conventional treatment for retinal neovascularization. These therapies successfully impede or stop the production. When administered locally or by precise intraocular injection.[10] In order to cure illnesses of the retina, gold nanoparticles have been shown to have anti-angiogenesis and anti-inflammatory characteristics.[5] Intravenous injection of gold nanoparticles demonstrated considerable anti-antigenic capabilities in the prior laser-induced choroid neovascularization (CNV) animal paradigm.[11]

Through the Akt/eNOS pathway, AuNPs are a powerful inhibitor of VEGF-induced RF/6A cell migration. After treatment with gold nanoparticles in C57BL/6 mice, the CNV created by laser ablation of Bruch's membrane was diminished. At therapeutic dosages, gold nanoparticles did not exhibit RPE cytotoxicity but did inhibit the tube formation and

proliferation of human umbilical vein endothelial cells (HUVEC) stimulated by vascular endothelial growth factor. In HUVECs D1, AuNPs prevented ERK1/2, Akt, and FAK from becoming phosphorylated.

3. Parkinson's and Alzheimer's disease Neuroprotective Effects

The blood-brain barrier (BBB), which enables some chemicals to flow through but prohibits others from doing so, is semi-permeable. Endothelial cells in the brain are closely packed together, making it impossible for chemicals to pass outside of the blood arteries. Brain disorders are notoriously challenging to cure. The BBB makes it challenging for medications to reach the brain, which is the cause. Nanoparticles can easily cross the blood-brain barrier, according to numerous studies.[10] As a result, future research can explore the potential of using nanoparticles to treat illnesses of the central nervous system. Depending on the cause, dementia can be categorised as degenerative, vascular, or reversible. Alzheimer's disease, front temporal lobe dementia, and Lewy body dementia are examples of degenerative dementia. Dementia of the most frequent type is Alzheimer's disease (AD). Oxidative stress may be the underlying mechanism causing the neurotoxicity brought on by B-Amyloid peptide (AB) aggregation.[10,8] Therefore, it is thought that inhibiting the development of a fibrils and breaking down an aggregates is a key therapy method for AD. Numerous researches have revealed that gold nanoparticles have the ability to penetrate the BBB.

The physical characteristics of nanogold (AuNPs) have been demonstrated in numerous studies to have hindered the aggregation of a peptides and the breakdown of a aggregates.[16,18,22] AuNPs likewise showed hindrance of acetylcholinesterase and butyrylcholinesterase, adding to an enemy of Alzheimer's sickness impact.[3] Furthermore, Ap might prompt mitochondrial brokenness by expanding oxidative pressure, so it could be connected with neurotoxicity in Promotion.[2] Oxidative pressure is one of the super obsessive occasions, since it adds to neuronal cell passing in Promotion. Ongoing examinations have tracked down that AuNPs (3-5 nm, 10 ppm) increment the reasonability of brain undeveloped cells presented to Aß, which is con nected with the lessening in the declaration of fiery cytokines, for example, Growth Putrefaction Component a (TNF-a) and Interleukin-18 (IL-10). Also, AuNPs decrease the Aß-interceded expansion in atomic element kappa-B (NF-kB, p65) AuNPs treatment altogether reestablished inducible nitric oxide synthase (NOS) and cyclooxygenase-2 (COX-2) levels in human brain immature

microorganisms (hNSCs) treated with AB. The hNSCs treated with AuNPs were essentially shielded from Ap-instigated oxidative pressure.

Moreover, the hNSCs co-treated with AuNPs were altogether safeguarded from the Aß-actuated decrease in the outflow of atomic variable erythrocyte 2 related factor 2 (Nrf2) and the downstream cell reinforcement target qualities (Grass 1, Turf 2, Gpx1, GSH) of Nrf2.

What's more, AuNPs diminished the outflow of HSP27 and HSP70 qualities. Also, AuNPs decreased the declaration of HSP27 and HSP70 qualities. All in all, AuNPs can neverse the aggravation and oxidative pressure actuated in hNSCs presented to Stomach muscle.[25]

Parkinson's sickness is perhaps of the most widely recognized neuromotor problem influencing the older and the second most normal neurodegenerative illness around the world. GNP (5-10 nm, 250 ug/ml.) were transfected into cells by endocytosis and hindered apoptosis in PC12 cells what's more, dopaminergic neurons.[9]

Gold nanoparticles (100 nm, 5-20 µg/ml.) biosynthesized from the rhizome of Paenia moutan possibly repressed the irritation in vitro murine microglial BV2.[6] Gold nanoparticles reduced the neuroinflammation and worked on engine coordination in Parkinson-actuated mice.[10]

4. Skin Problems

Wound mending includes a muddled pathophysiological process that remembers for flammation, expansion, and redesigning Bacterial contamination brought about by the absence of legitimate therapy of intense injuries is one of the fundamental explanations behind the development of constant injuries. As microscopic organisms can cause irritation, killing microbes is a significant part of starting injury treatment. Quantized gold (QG) can go about as an endotoxin bad guy in diminishing inflam-mation and keeping a constant injury from (re)occurring, after which the injury bed will change from the irritation stage to the multiplication stage.[2] Such a gold nanocomposite could be additionally planned as double capability quantized gold (QC), to tie with LPS, not impacting the reactant capability of the inward center.

The synergist decom-position of H-O into water and oxygen on little measured nanogold is more productive than such decay on enormous estimated impetuses.[8] Twisted fix after hemostasis might be convoluted by contamination; thusly, platelet-like particles (PLP) can be joined with antibacterial gold to create nanogold composites (NCC) to grow wound mending.

These NGC PLPs emulate the morphology of platelets, produce clump shrinkage, show certain an-tibacterial potential, and are promising materials for forestalling post-awful blood misfortune and disease.[9] Previously, we likewise found that the mix of gold nanoparticles and epigallocatechin gallate (EGCG) and a-lipoic corrosive (ALA) essentially sped up the recuperating of skin wounds in mice.

Our discoveries give a hypothetical premise to the future improvement of AuNPs and other cell reinforcement combinations in the skin treatment of skin wounds.[3] The pathophysiology of skin break out vulgaris relies upon dynamic sebaceous organs, and that implies that specific obliteration of sebaceous organs might be a viable treatment. Microparticles with a 120-mm breadth silica center and a 15-nm thick gold shell were picked as they give solid light ingestion at - 800 nm. Microscopy showed particular ther-mal harm to sebaceous organs and organs following openness to 10-50 cm 30 ms. 800 nm diode laser beats.[1]

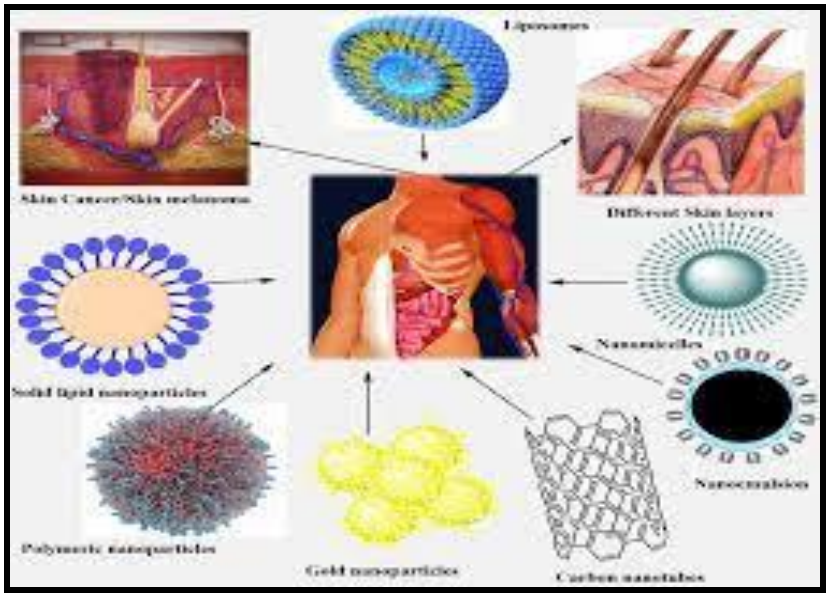

Fig-"2". Nanoparticles in a Skin Problems Treatment.

5. Inflammatory Bowel Diseases (IBD)

A new gold (III) complex was designed and screened in in vitro studies, using a mouse macrophage cell line, RAW264. 7, as well as in vivo, in a dextran sulfate sodium (DSS)-induced mouse model of colitis.[3] In lipopolysaccharide (LPS)-stimulated RAW264. 7 cells, the complex showed a potent anti-inflammatory profile, as evidenced in neutral red uptake and Griess tests. In the dextran sodium sulfate (DSS)-induced mouse model of colitis, the gold (II) complex (1. 68 and 16-8 ug/kg) produced a significant anti-inflammatory effect. The underlying mechanisms could be related to the anti-oxidant effect (as evident by decreasing

tissue MDA) and anti-inflammatory potential of AuNPs.[4] Moreover, the gold (II) complex induced changes in the tight junction complex expression in the intestinal wall.

This is the first study proving that gold (1) complexes may have therapeutic potential in the treatment of IBD.[2] On the other hand, oral gold nanoparticles (5 nm, 25 ug/kg) can prevent colitis by attenuating the inflammatory response mediated by Toll-like receptor 4 and reactive oxygen/nitrogen substances, but may lead to imbalance of the intestinal flora of mice.[4] Therefore, the above research results show that gold nanoparticles have great potential as a novel therapeutic strategy for the treatment of inflammatory bowel disease.

6. Disorder of the Bone Cartilage

J. Forestier identified gold salt as a medication to treat rheumatoid arthritis as early as 1929.[5] Later investigations established the efficacy of gold medications for rheumatoid arthritis patients. According to studies, AuNP (15 nm, 25 g/kg) can enhance theIn collagen-induced arthritis (CIA) animals, oxidative stress and inflammatory mediator production were observed.[6] Although the specific origin of rheumatoid arthritis (RA) is unknown, the breakdown of articular cartilage is brought on by inflammatory mediators such TNF-, IL-1, COX-2, and nitric oxide (NO).

After administering AuNPs to CIA rats, it was discovered that levels of inflammatory mediators such TNF-, IL-1, COX-2, and the activated transcription factor NF-B were considerably decreased. Additionally, without causing any evident negative effects, Au clusters (5 mg/kg) can successfully suppress the inflammatory signs of CIA in rats and prevent joint injury.[7,3] On the other hand, nanogold (13 nm, 10 g) could block the RA mechanism by interacting with VEGF and preventing endothelial cell growth and migration.

Additionally, AuNPs (13 or 50 nm; 3. 76 g) can block ROS and stop RA synovitis from being destroyed.[7] In order to protect cartilage tissue in arthritis, AuNPs can block angiogenic activity, reduce inflammation, or act as antioxidants. Studies have demonstrated that AuNPs are one of the best nanoparticles for treating illnesses of the bone tissue because they have the capacity to suppress osteoclasts.[7,9]

7. Cancer

Nanoparticles, particularly gold nanoparticles, have found significant use in the detection and treatment of cancer.

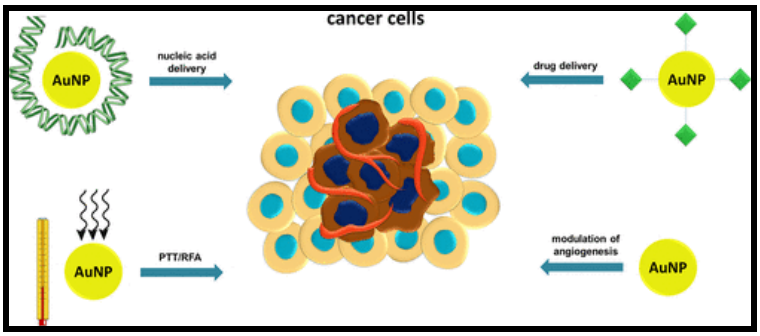

Fig-"3" Cancer cells.

7. 1. Radiosensitization, Photothermal, and Photodynamic Therapy

According to recent research, the combination of glucose nanogold particles and curcumin (20 L per 1 mL medium) has a significant potential for reducing tumour hypoxia and increasing the radiosensitivity of breast cancer stem-like cells, opening the door for the creation of new, highly effective and minimally toxic radiosensitizers.[40] E. coli outer membrane vesicles attached to gold nanoparticles (Au-OMV) at concentrations of 200 g/mL and 2 g/mL correspondingly for Au and OMV) paired with Successfully, radiation results in radiosensitization and immunomodulatory effects. both in situ and subcutaneous GL261 glioma cells tumor-bearing tumour growth inhibition (brain) C57BL/6 mice with tumours. Intracellular reactive oxygen species (ROS) are significantly elevated in GL261 glioma cells when Au-OMV and radiation are combined.[4]

Chitosan-capped gold nanoparticle-loaded doxorubicin (CS-GNPs-DOX, 25 nm; 0. 1 mM Au concentration), according to recent experimental findings, can improve the effectiveness of radiotherapy. chemotherapy, which causes cell necrosis and increases DNA double-strand breaks, to diminish cancer cell viability considerably, even at relatively low radiation doses (0. 5-Gray,Gy). The created multifunctional CS-GNPs-DOX in particular offers a synergistic a cancer treatment option that efficiently delivers the drug doxorubicin to tumour cells and boost radiosensitizing action, lowering the dose needed for conventional radiation treatment (2). GNPs' degradation on anticancer drugs can be stopped by binding to them. decreasing the formulation's toxicity to healthy tissues as they make their way to tumours. Photosensitizers (PS) (PS) To create new formulations of PDT, photosensitizers (PS) are mixed with GNPs (2-4 nm in diameter) of diverse shapes and sizes. A photosensitive medication can be transported by gold nanoparticles. Different chemicals can either make the surface of NPs covalent (by using linkers containing thiol or amino groups) or non-covalent (for example, by electrostatic interactions).

Active nanoparticles have the ability to efficiently absorb light energy and boost PS excitation, boosting singlet oxygen and free radical generation.[3] Reduced non-specific distribution, near-infrared (NIR) activation, and application in several cancer photothermal treatment (PTT) and drug delivery systems make gold nanoparticles (approximately 2–50 nm) advantageous for PTT of cancer. The surface plasmon resonance induction of GNPs, for example, causes a considerable increase in light absorption/scattering and may even cause the NPs to heat up. Growth hormone receptor protein is frequently found on the surface of cancer cells (such as epidermal growth factor receptor, EGFR). These proteins are rarely expressed in normal cells. Nanogold has an antibody affixed to its surface that can identify EGFR. This complex may locate cancer cells in people and cling to their surfaces, forming images that can be used in imaging medicine.[4]

7. 2. Drug distribution

Gold nanospheres labeled with peptides containing isoAsp-Gly-Arg (isoDGR) are an αvβ3 integrin-binding motif, proving an effective carrier for delivering pro-inflammatory cytokines to the tumor vasculature. In vivo studies performed in murine model of fibrosarcoma showed that low doses of bifunctional nanoparticles bearing isoDGR and TNF (corresponding to few nanoparticles per cell) delayed tumor growth and increased the efficacy of doxorubicin, without worsening its toxicity. Similar effects were obtained using trifunctional nanoparticles loaded with isoDGR, TNF, and IL12. A few hours after injection, doxorubicin penetration in tumours was increased by nanoparticles containing isoDGR and TNF, according to mechanistic investigations, and later time points resulted in vascular damage.[5]

Gallic acid (GA) was delivered to cancer cells using 15-nm spherical gold nanoparticles in order to increase the effectiveness of anti-cancer activities. The capacity of GNPs-GA complex to stop the proliferation of cervical cancer cells is diminished when compared to unaltered GA. It's interesting to note that whereas GA alone is hazardous to normal cells, high concentration (150 M) GNPs-GA is not. In summary, GNPs-GA does not decrease cervical cancer cell proliferation as effectively as GA does, but it does not cause cytotoxicity in healthy cells.

In order to lessen the negative effects of radiotherapy and chemotherapy, gold nanoparticles may be employed as a substitute phytochemical delivery method for the treatment of cancer.[6,7] Resveratrol alone, however, does not have the same anti-tumor benefits as nano-gold loaded with resveratrol (Res-GNPs, 39 nm), which may be because gold nanoparticles

are found in mitochondria and carry more resveratrol into cells. These findings suggest that Res-GNPs have both in vitro and in vivo anticancer effects that are significantly superior to Res alone and may be useful in the clinical treatment of liver cancer.[8]

Pegylated gold nanoparticles (PEGAuNPs, 24 nm, 9. 8 nM) joined with chemotherapy drugs (doxorubicin or varlitinib) likewise have a very great cytotoxic impact on pancreatic disease cells.[9] Poison from naja toxin (NN-32,IC50: 5. 0 µg/mL) joined with gold nanoparticles (18 nm) expanded the rate of cytotoxic action and apoptosis of two human bosom malignant growth cell lines (MCF-7 and MDA-MB-231).[5]

7. 3. Modulation of Apoptosis, Angiogenesis, and Migration

A collection of growth factors, including fibroblast growth factor (FGF), platelet-derived growth factor (PDGF), and most significantly, vascular endothelial growth factor (VEGF), a well-known angiogenesis activator, are the key targets for reducing angiogenesis. It is expressed during metastasis and tumour progression. Pro-angiogenic heparin-binding growth factors (HB-GFs), such as vascular endothelial growth factor 165 (VEGF165) and basic fibroblast growth factor (bFGF), might be inhibited by gold nanoparticles (5-20 nm, 5 nM).[1] The combination of gold nanoparticles and heparin-binding growth factors (HB-GFs) limits its action by altering the structure of the protein, according to the mechanism.[5] In comparison to B chronic lymphocytic leukaemia (CLL) cells treated to AbVF or GNP alone, Gold-AbVF (antibody to VEGF) (4 nm, 200 g/mL) dramatically increases apoptosis.[2]

Due to their specific cytotoxicity against melanoma cells and suppression of cell migration, AuNPs of 3-5 nm (2-10 ppm) may be effective anticancer agents. Additionally, pretreatment with 3-5 nm AuNPs decreased the migration and motility of melanoma cells stimulated by platelet-derived growth factor BB. The adherence of melanoma cells to collagen may be considerably inhibited by 3-5 nm AuNPs, according to adhesion assay results. As a result of their specific cytotoxicity against melanoma cells and suppression of their motility, 3-5 nm AuNPs may be prospective anticancer agents.[5] On the other hand, in a 7,12 dimethylbenz(a)anthracene (DMBA)-induced breast cancer mouse model, gold nanoparticles from green production were tested for their anticancer efficacy. At room temperature, chloroauric acid (HAuCl4) was employed to create AuNP while curcuma longa was used as an aqueous reducing extract and stabiliser. The study's findings showed that the majority of created AuNPs were spherical, with some size differences (in the range of 10–30 nm). the

group receiving AuNPs treatment following breast cancer induction revealed lymph node and breast lesions from a degenerative tumour.[4]

8. Cardiovascular and Cardiac Injury

Cell adhesion molecules (CAMs) generated by TNF- were prevented from expressing in aorta and human umbilical vein endothelial cells (ECs) by AuNPs. By boosting their ubiquitination, AuNPs accelerated the degradation of CAM proteins, which in turn decreased TNF-induced intracellular ROS generation and the NF-B signalling pathway. However, they had no effect on TNF- binding to Ecs or the mTOR pathway of protein synthesis. This work shown that AuNPs can inhibit arterial neointimal hyperplasia during vascular injury in vivo and have anti-inflammatory biological effect against vascular Ecs in vitro. After three days of oral dosing, the serum gold concentration was 99. 5 with an error of 18 ng/mL.[5]

Additionally, 20-nm citrate-covered gold nanoparticles (cit-AuNP) prevented BBB failure, decreased the concentration of TNFF- in the brain, and expressed ICAM-1 in circulating polymorphonuclear (PMN) leukocytes and cerebral blood vessels in septic mice, as well as reducing the adhesion of white blood cells and platelets to cerebral blood vessels.[56] To prevent sepsis-related encephalopathy, the combination of nanogold with antibiotics may be a suitable therapeutic option for the treatment of sepsis. It was discovered that 20 nm Au-NPs (800–2400 g mL–1) can prevent oxygen-glucose deprivation/reperfusion (OGD/R) damage to primary cortical neurons. This protection may be achieved by lowering apoptosis and oxidative stress while activating Akt signalling and mitochondrial pathways. According to the study's findings, Au-NPs may one day serve as a treatment for ischemic stroke.[7]

Gold nanoparticle solution made from cyanobacteria extract exhibits anti-myocardial infarction and antioxidant properties. After administering isoproterenol to rats to cause myocardial infarction, either cyanobacteria extract or gold nanoparticles were administered. The findings demonstrated that isoproterenol can alter the ECG, arterial pressure index, and cardiac antioxidant capacity by altering the concentration of gold nanoparticles (41. 7 nm, 200 mg/kg/day, intra peritoneal) alone or in conjunction with cyanobacteria extract.[8]

On the other hand, collagen I was targeted in myocardial infarction using CT vascular imaging of coronary arteries and AuNPs conjugated to collagen-binding adhesion protein 35 (CNA35). Six hours after intravenous (i. v.) treatment, AuNP signal was still visible in blood,

which is a lot longer than the half-life of medications based on iodine (5–10 min). Imaging systems have showed promise when using AuNPs as contrast agents.[9]

9. Synergistic Activity of Natural Products

The primary barriers to the use of natural products in drug development have traditionally been their poor bioavailability, ease of oxidation, first-pass metabolism, and fast efflux. By stimulating apoptosis in mice models, (-)-Epigallocatechin-3-gallate (EGCG)-gold nanoparticles (25 M: 2. 5 or 1 ppm) (EGCG-npNG) demonstrated synergistic anti-cancer effect and suppressed the growth of melanoma and bladder cancer tumours. Gold nanoparticles (13. 6 nm) can be used as an efficient delivery vehicle for EGCG and show good potential to boost anti-cancer activity in Ehrlich ascites cancer-bearing mice. In vitro and in vivo, EGCG-GNPs (30 nm) shown superior anti-osteoclast properties than free EGCG

10. Antimicrobials

Since AuNPs are so small, they can easily pass through bacterial cell walls, disrupting their physiological processes and resulting in cell death. AuNPs' precise antibacterial action is yet not completely understood. However, other potential mechanisms include altering gene expression and cell signaling, producing ROS and oxidative stress, causing cellular organ dysfunction, and inducing microbial death through membrane damage. When added to a cream mixture, gold nanoparticles used in external preparations did not aggregate. The gold nanoparticles remained stable even after being added to the cream mixture because of the stronger electromotive force on their surface. Microbiological experiments reveal that the examined creams with gold nanoparticles exhibited various bactericidal effects against Saccharomyces cerevisiae and Aspergillus niger. The permeability of metal nanoparticles across the dermal membrane was demonstrated for samples with a concentration of 110-200 mg/kg.

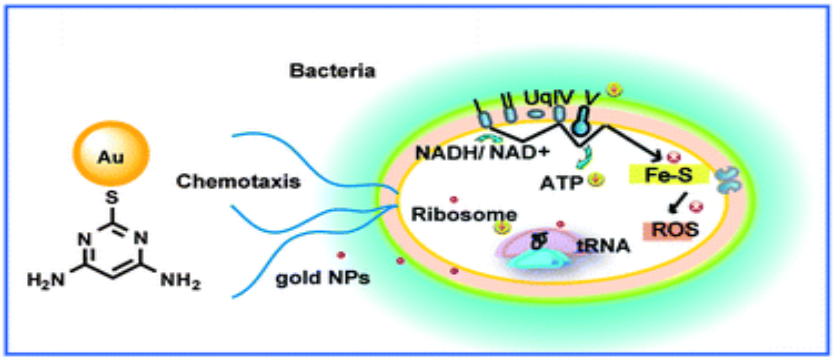

Fig-"4" NanoParticles as Antimicrobial.

Contact-based antibacterial medications can leverage general interactions with bacterial cells to exert antibacterial activity as a non-antibiotic technique. This is a futuristic response to the issue of bacterial resistance on a worldwide scale. Consideration of the direct bonding of cationic guanidine-containing amino acids to the surface of a nano-gold carrier is a very condensed approach that has been developed. The direct cationic guanidine-containing amino acid binding to the nano-gold carrier's surface is taken into account in this design. The structure possesses antibacterial activity because of the high density of cationic surface charge.[6]

The research employed DNA molecular probes and gold nanoparticles to identify individual Mycobacterium tuberculosis DNA fragments. The goldnanoparticle reagent (13 nm, 0. 5 nM) will change colour from red to blue when a specific DNA fragment of Mycobacterium tuberculosis is present as a result of the surface plasmon resonance effect. Consequently, As a result, gold nanoparticles and DNA molecular probes are used to quickly diagnose Mycobacterium tuberculosis.[7]

11. Metabolic Syndrome and Other Conditions

Studies have demonstrated that new gold nanoparticles can lower blood glucose, liver enzyme concentrations, and white blood cell counts in diabetic rats by green synthesising them from extract of Erythrina japonica. Additionally, they can considerably reduce the expression of TNF- and IL-6 genes in type 2 diabetes-related visceral adipose tissue. The findings demonstrate that Au NPs (9 nm, 2. 5–5 mg/kg) are new and effective nanomaterials for the treatment of diabetes.[6]

By inhibiting tumour necrosis factor (TNF), gold nanoparticles (21 nm) also have anti-inflammatory properties. A study used C57BL/6 mice that were given a pellet high-fat diet (HFD, 43% as fat) and treated daily for nine weeks with low doses (HFD-LAu) or high doses (HFDHAu) of AuNPs administered intraperitoneally. In comparison to the HFD-HAu group, which had a 5% weight loss and significant improvements in both hyperlipidemia and glucose intolerance, the HFD-LAu group displayed an 8% drop in body weight, ameliorated hyperlipidemia, and normal glucose tolerance.[69]

For lipolysis, nanogold, hyaluronic acid, and adipocyte targeting peptide can be employed. Induces white fat lipolysis and lowers body weight in obese mice through targeted near-infrared laser irradiation.[7]

Increased effects during liposuction can be obtained by injecting nanogold-coated polyethylene glycol into adipose tissue.[1] The creation of coronavirus vaccines and virus detection have been two of nanogold's most significant recent uses. These studies emphasise how important nanogold particles are to biomedicine.[5]

12. CONCLUSIONS

Depending on the particle size, the distribution of nanogold after systemic delivery may differ. Gold nanoparticles that are larger may remain in the liver. The brain, heart, lungs, spleen, and kidneys are just a few of the organs where small gold nanoparticles can be found. The kidneys are where the smaller particles are then excreted from the body. Of fact, the nanoparticle can avoid being phagocytosed by tissue macrophages if it enters different organs and tissues. The location of the tissue illness will be further reached.[9] Due to their direct contact with the target location, topical uses of nanoparticles, such as ocular formulations, can successfully accomplish the therapeutic objectives covered in this work. Gold nanoparticle toxicity may be strongly influenced by elements such particle size, shape, surface potential, dose, and production technique. Therefore, more thorough toxicological experiments are needed to demonstrate the safety of gold nanoparticles before they may be used in clinical settings. The majority of the associated gold nanoparticle formulations are still undergoing clinical trials at this time. The majority of nanogold-related medications that the FDA has approved for clinical use contain nanogold in combination with cancer-treating or cancer-diagnosing proteins or anticancer medications (like paclitaxel). Clinical trials and fundamental studies on nanogold are now under way. In the future, more nano-related preparations will be used in clinical illness treatment and diagnosis, increasing the importance of nanogold and nanogold in biomedicine.[8,9]

REFERENCES

1. Sztandera, K.; Gorzkiewicz, M.; Klajnert-Maculewicz, B. Gold Nanoparticles in Cancer Treatment. Mol. Pharm. 2019; 16: 1–23.
2. Canli, E. G.; Ila, H. B.; Canli, M. Response of the antioxidant enzymes of rats following oral administration of metal-oxide nanoparticles (Al2O3, CuO, TiO2). Environ. Sci. Pollut Res. Int., 2019; 26: 938–945.
3. Tuncsoy, B. S.; Tuncsoy, M.; Gomes, T.; Sousa, V. S.; Teixeira, M. R.; Bebianno, M. J. Ozalp, P. Effects of Copper Oxide Nanoparticles on Tissue Accumulation and Antioxidant Enzymes of Galleria mellonella L. Bull. Environ. Contam. Toxicol. 2019; 102: 341–346.

4. Luo, J.; Zhang, Y. ; Zhu, S. ; Tong, Y. ; Ji, L. ; Zhang, W. ; Zhang, Q. ; Bi, Q. The application prospect of metal/metal oxide nanoparticles in the treatment of osteoarthritis. Naunyn-Schmiedeberg Arch. Pharmacol. 2021; 394: 1991–2002.
5. Hammami, I. ; Alabdallah, N. M. ; Al Jomaa, A. ; Kamoun, M. Gold nanoparticles: Synthesis properties and applications. J. King Saud Univ. Sci., 2021; 33: 101560.
6. Dykman, L. ; Khlebtsov, N. Gold nanoparticles in biomedical applications: Recent advances and perspectives. Chem. Soc. Rev., 2012; 41: 2256–2282.
7. Shi, Y. ; Han, X. ; Pan, S. ; Wu, Y. ; Jiang, Y. ; Lin, J. ; Chen, Y. ; Jin, H. Gold Nanomaterials and Bone/Cartilage Tissue Engineering: Biomedical Applications and Molecular Mechanisms. Front. Chem., 2021; 9: 724188.
8. Scheive, M.; Yazdani, S. ; Hajrasouliha, A. R. The utility and risks of therapeutic nanotechnology in the retina. Ther. Adv. Ophthalmol. 2021; 13: 251584142110033.
9. Liang, I. C. ; Ko, W. -C. ; Hsu, Y. -J. ; Lin, Y. -R. ; Chang, Y. -H. ; Zong, X. -H.; Lai, P. -C.; Chang, D. -C.; Hung, C. -F. The Anti-Inflammatory Effect of Hydrogen Gas Inhalation and Its Influence on Laser-Induced Choroidal Neovascularization in a Mouse Model of Neovascular Age-Related Macular Degeneration. Int. J. Mol. Sci., 2021; 22: 12049.
10. Kaur, I. P.; Kakkar, S. Nanotherapy for posterior eye diseases. J. Control. Release, 2014; 193: 100–112.