1.INTRODUCTION:-

Cancer is a group of diseases involving abnormal cell growth with the potential to invade or spread to other parts of the body. These contrast with benign tumors, which do not spread. Possible signs and symptoms include a lump, abnormal bleeding, prolonged cough, unexplained weight loss and a change in bowel movements. While these symptoms may indicate cancer, they can also have other causes. Over 100 types of cancers affect humans.

Tobacco use is the cause of about 22% of cancer deaths. Another 10% are due to obesity, poor diet, lack of physical activity or excessive drinking of alcohol. Other factors include certain infections, exposure to ionizing radiation and environmental pollutants. In the developing world, 15% of cancers are due to infections such as Helicobacter pylori, hepatitis B, hepatitis C, human papillomavirus infection, Epstein–Barr virus and human immunodeficiency virus (HIV). These factors act, at least partly, by changing the genes of a cell. Typically, many genetic changes are required before cancer develops. Approximately 5–10% of cancers are due to inherited genetic defects from a person's parents. Cancer can be detected by certain signs and symptoms or screening tests. It is then typically further investigated by medical imaging and confirmed by biopsy.

Many cancers can be prevented by not smoking, maintaining a healthy weight, not drinking too much alcohol, eating plenty of vegetables, fruits and whole grains, vaccination against certain infectious diseases, not eating too much processed and red meat and avoiding too much sunlight exposure. Early detection through screening is useful for cervical and colorectal cancer. The benefits of screening in breast cancer are controversial. Cancer is often treated with some combination of radiation therapy, surgery, chemotherapy and targeted therapy. Pain and symptom management are an important part of care. Palliative care is particularly important in people with advanced disease. The chance of survival depends on the type of cancer and extent of disease at the start of treatment. In children under 15 at diagnosis, the five-year survival rate in the developed world is on average 80%. For cancer in the United States, the average five-year survival rate is 66%.

In 2015, about 90.5 million people had cancer. About 14.1 million new cases occur a year (not including skin cancer other than melanoma). It caused about 8.8 million deaths (15.7% of deaths). The most common types of cancer in males are lung cancer, prostate cancer, colorectal cancer and stomach cancer. In females, the most common types are breast cancer, colorectal cancer, lung cancer and cervical cancer. If skin cancer other than melanoma were included in total new cancer cases each year, it would account for around 40% of cases. In children, acute lymphoblastic leukemia and brain tumors are most common, except in Africa where non-Hodgkin lymphoma occurs more often. In 2012, about 165,000 children under 15 years of age were diagnosed with cancer. The risk of

cancer increases significantly with age, and many cancers occur more commonly in developed countries. Rates are increasing as more people live to an old age and as lifestyle changes occur in the developing world. The financial costs of cancer were estimated at $1.16 trillion USD per year as of 2010.

2.LITERATURE REVIEW:-

1. **AK Khan, R Rashid, G Murtaza and A Zahra**

Gold nanoparticles have, in some ways, revolutionized the field of medicine because of its wide spread applications in targeted drug delivery, imaging, diagnosis and therapeutics due to their extremely small size, high surface area, stability, non-cytotoxicity and tunable optical, physical and chemical properties. Functionalized gold nanoparticles with various biomolecules such as proteins, DNA, amino acids and carboxylic acids have been used in cancer therapy and provide excellent drug delivery system. Targeted delivery and programmed release of therapeutic drugs to the specific site is achieved by using gold nanoparticles because they can bear high drug load and release it to the specific site through various administration routes and can interact with cancerous cell. Side effects of conventional drugs have been minimized by conjugation with gold nanoparticles and they increase the quality life of patients.

2. Vijayakumar.S, Paulsi.S

Tumor targeted drug delivery nanoparticles systems must address technical and biological concerns that influence their distribution. More extensive investigation is required to understand the bio distribution and fate of gold nanoparticles after the exposure. It has been found that normally biodegradable substances are decomposed and their waste products are excreted by the kidneys and
intestines. However, non-biodegradable nanoparticles have been studied and it seems that they accumulate in certain organs, especially to the liver. It is clear that AuNPs offer various advantages over bulky structures and the characteristic properties of gold nanoparticles make them ideal for diagnostic purpose and several biomedical applications. Though many of the technologies involving nanoparticles for cancer detection and treatment are mainly in preclinical stages, there is tremendous potential for nanotechnology to enable desperately needed for cancer detection in its early stages.

3. Hengte Ke, Jinrui Wang, Zhifei Dai,* Yushen Jin, Enze Qu, Zhanwen Xing, Caixin Guo, Xiuli Yue, and Jibin Liu

In conclusion, we successfully constructed GNS-MCs composed of ultrasound-responsive polymeric microcapsules for systemic contrast-enhanced ultrasound imaging diagnosis, and NIR-absorbing gold nanoshells on the surface for remote photohyperthermia. HeLa cells incubated with GNS-MCs
in vitro can be killed photothermally by exposure to NIR light. Meanwhile, GNS-MCs can still maintain adequate acoustic properties that are required to act as an ultrasound contrast agent. Thus, the dual-functional nano/micro composites hold a great potential for ultrasound-guided photothermal tumor therapy. This simple and highly efficient theranostic agent would remarkably improve the methodologies for cancer diagnosis and therapy.

4. **Ahmad Shanei, Ameneh Sazgarnia, Elham Dolat, Leila Hojaji-Mohammadreza Sehhati, Milad Baradaran-Ghahfarokhi1.**

In conclusion, in this study the synergic effects of MX-incubated GNPs as dual treatment of microwave hyperthermia and chemotherapy for melanoma cancer therapy was evaluated. Results showed that, melanoma cells's survival was significantly decreased due to MX chemotherapy in synergism with GNPs hyperthermia under MW irradiation.

5. **Celina Yang, Kyle Bromma,**

The GNP-based platform proposed in this study has the potential for delivering chemotherapeutics more efficiently than free drugs, while at the same time acting as a radiosensitizer as summarized in Fig. 5a–c. Introduction of anticancer drug carrying GNPs into the radiation treatment protocol would give rise to 32 ± 9% decrease in tumor cell survival fraction and statistically significant increase in DNA DSBs. Most importantly, the effectiveness of this GNP-mediated chemoradiation was observed at a relatively low 0.3 nM incubation concentration of GNPs. GNPs are also being used in photothermal therapy and photodynamic therapy (Jelveh and Chithrani 2011). Hence, GNP-based multifunctional GNP platform could facilitate the combination of a wide range of therapeutic modalities for delivering a higher therapeutic load to destroy therapeutic resistant tumor cells. With appropriate engineering, these GNP-based platforms have the capacity for controlled delivery of therapeutic doses, while minimizing toxicity to the healthy organs and tissues. It is generally recognized that in vitro data cannot be extrapolated directly to in vivo or clinical settings, since assays in vitro assays do not account for tumour microenvironmental factors and the fact that tumors may contain clonogenic subpopulations of cells with different sensitivities to radiation or chemotherapeutic of interest (Hill and Robert 2008). Further modifications to the GNP-based platform will be performed by the authors and will be tested for in vivo studies.

3.GOLD NANOPARTICLES:-

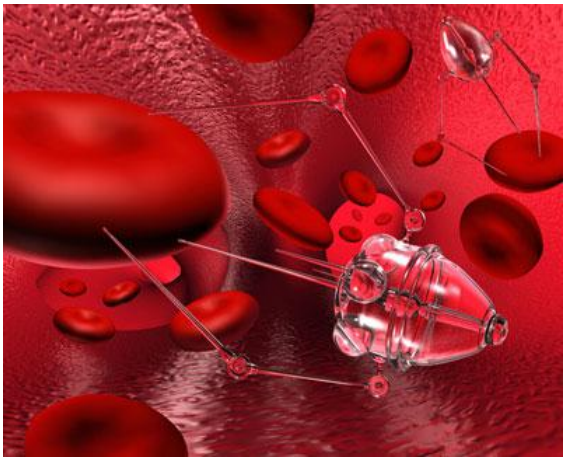
Gold nanoparticles in chemotherapy and radiotherapy is the use of colloidal gold

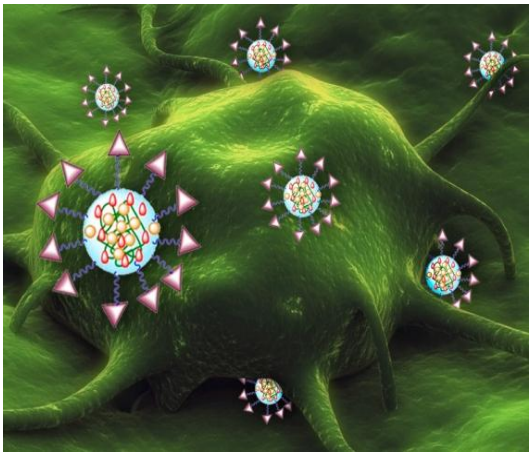
in therapeutic treatments, often for cancer or arthritis. Gold nanoparticle

technology shows promise in the advancement of cancer treatments.

Some of the properties that gold nanoparticles possess, such as small size, non-toxicity and nonimmunogenicity make these molecules useful candidates for targeted drug delivery systems.

With tumor-targeting delivery vectors becoming smaller, the ability to by-pass the natural barriers and obstacles of the body becomes more probable. To increase specificity and likelihood of drug delivery, tumor specific ligands may be grafted onto the particles along with the chemotherapeutic drug molecules, to allow these molecules to circulate throughout the tumor without being redistributed into the body.





Nanotechnology cancer treatments uses gold particles to carry anticancer drugs straight to the cancer.

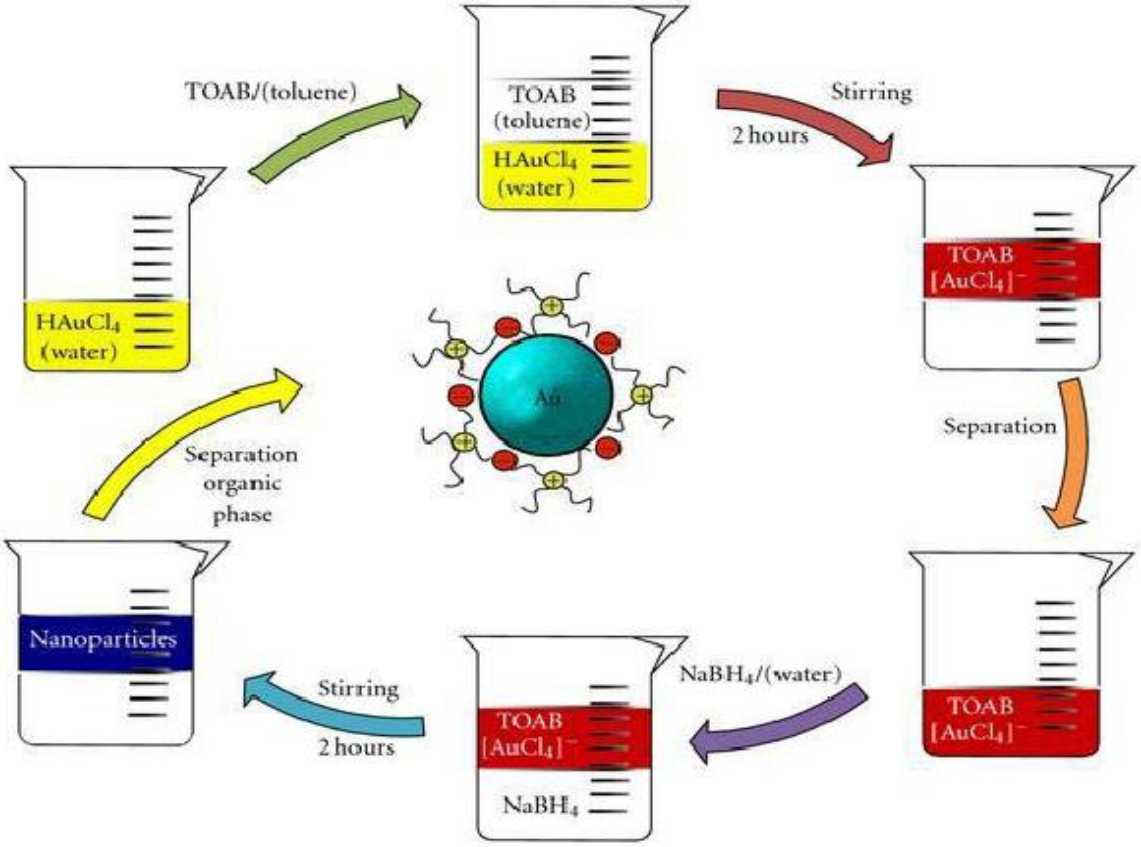
4.SYNTHESIS:-

A wide array of solution based approaches has been developed in the past few decades to control as the size, shape, and surface functionality. Turkevich et al. developed a synthetic method for creating AuNPs in 1951 by treating hydrogen tetrachloroaurate ($HAuCl_4$) with citric acid in boiling water, where the citrate acts as both reducing and stabilizing agent (Scheme 2B). Frens further refined this method by changing the gold-to-citrate ratio to control particle size. This protocol has been widely employed to prepare dilute solutions of moderately stable spherical AuNPs with diameters of 10 to 20 nm, though larger AuNPs (e.g., 100 nm) can also be prepared.

These citrate-stabilized AuNPs can undergo irreversible aggregation during functionalization process with thiolate ligands. Several strategies have been developed to conquer this problem including using a surfactant, Tween 20, prior to the modification to prevent aggregation (Scheme 2B), or using thioctic acid as an intermediate via a two-step functionalization. However, the requirement for high dilution makes large scale production challenging.

4.1.BRUST METHOD:-

He achieved a breakthrough in AuNP synthesis in 1994 by creating organic soluble alkanethiol-stabilized AuNPs through a biphasic reduction protocol using tetraoctylammonium bromide (TOAB) as the phase transfer reagent and sodium borohydride(NaBH4) as the reducing agent (Scheme 2A). This methodology produces low dispersity AuNPs from 1.5 to 5 nm by varying the reaction conditions such as gold-to-thiol ratio, reduction rate, and reaction temperature. These alkanethiol-protected AuNPs possess higher stability when compared to most other AuNPs due to the synergic effect of the strong thiol-gold interactions and van der Waals attractions between the ligands.



4.2.TURKEVICH METHOD:-

1.Small amounts of hot chlorauric acid is reacted with small amounts of sodium citrate solution.The colloidal gold will form because the citrate ions act as both reducing agents and capping agent.

2.Due to this monodisperse gold nanospheres are produced.

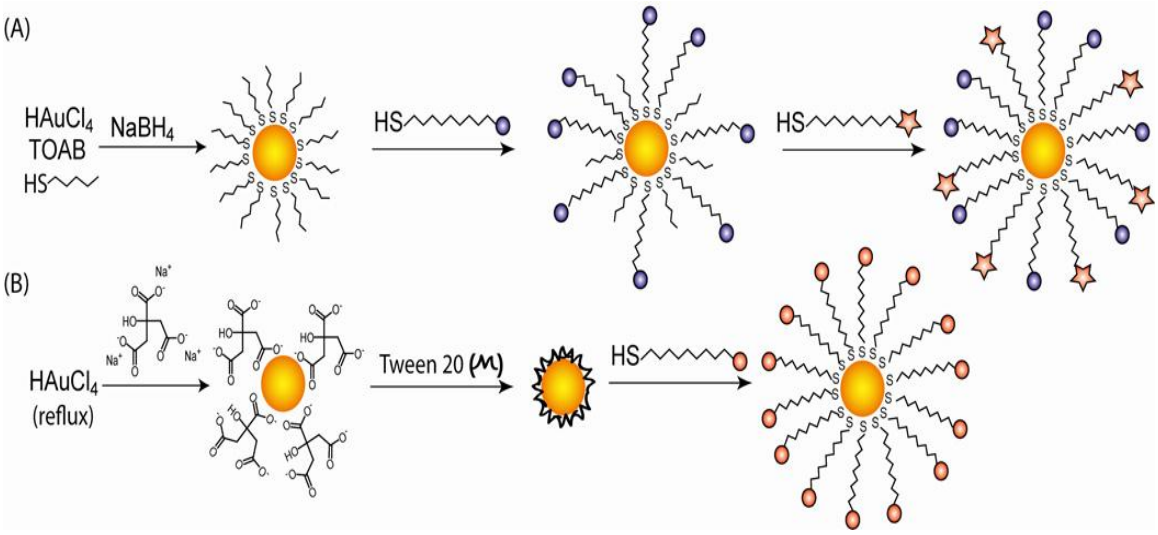
3.The size of nanospheres can be controlled by varying the citarte/gold ratio.

4.The major limitations of this method are low yield and the restriction of using water as solvent.

4.3.MARTIN METHOD:-

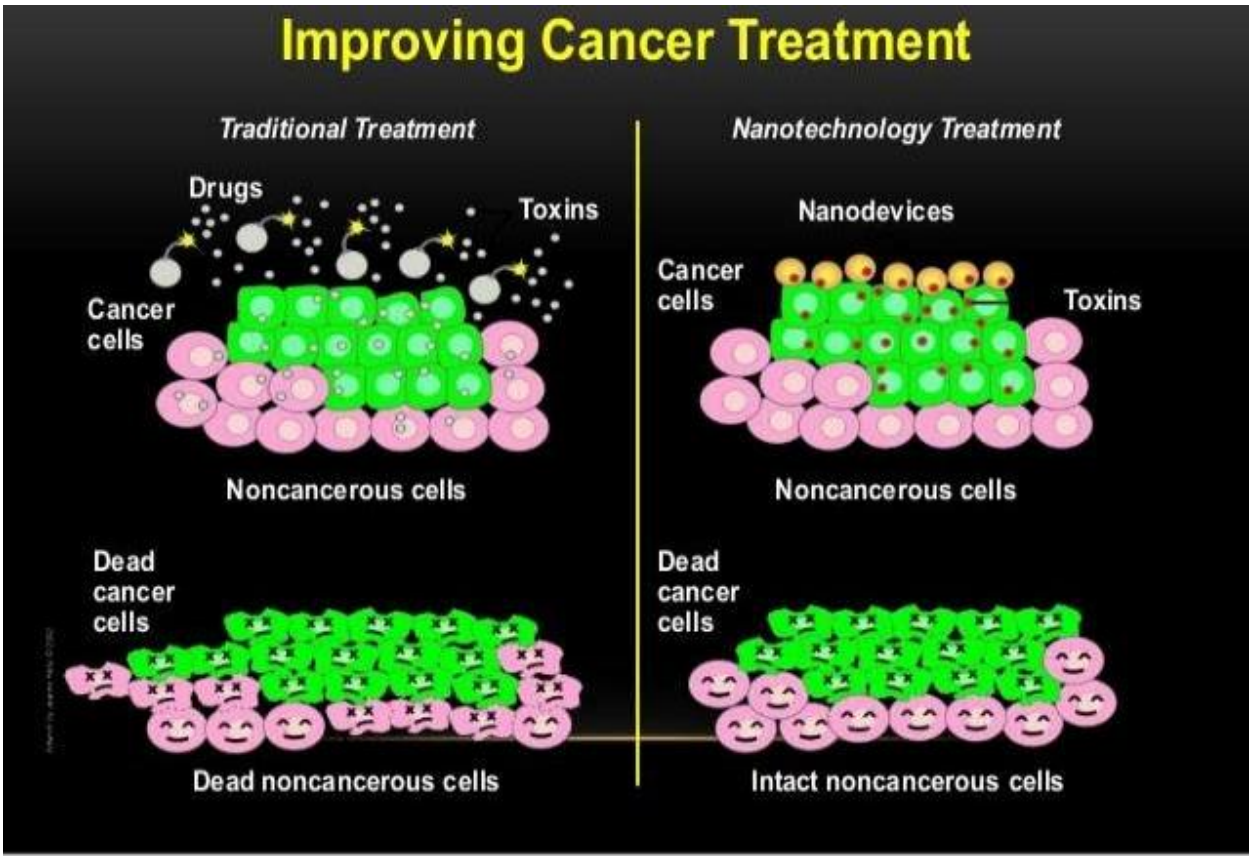
1.Gold nanoparticles are produced in water by reducing HAuCl4 with NaBH4. Even without any other stabilizer like citrate, gold nanoparticles are stably dispersed.

2.The key is to stabilize HauCl4 and NaBH4 in the aqueous stock solutions with HCl and NaOH for >3 months and >3 hours respectively.



5.MECHANISM:-

Gold nanoparticles (GNPs) have been engineered such that their Plasmon resonance is tuned to near infrared (NIR) wavelenghts, which allows them to absorb and convert this energy to heat leading to hyperthermic temperatures of surrounding media. As a result the GNPs have received increased attention for localized administration of hyperthermia for cancer cells ablation, and this approach is currently in early clinical trials.



6.CHARACTERISTICS:-

1.Gold nanoparticles are chemically inert.

2.These have greater biological compatibility.

3.Optical properties like plasmon resonance are fluroscene and chemiluminscene having better exhibited by gold nanoparticles.

4.Gold Nanoparticles provide microscopic probes for the study of the cancer cell.

5.Gold nanoparticles accumlate in the cancerous cell and show cytotoxic effect i.e. necrosis of the specific cell and cell specific receptor.

6.These have high stability due to the gold-sulphur bonds.

7.SIZE OF GOLD NANOPARTICLES:-

Gold nanoparticles range in size depending on which therapy they are being used for.

In photothermal cancer

therapy, many gold nanoparticle molecules are used in each test and they must all be uniform in size. Including PEG coating, the nanoparticles measured

to be ~130 nm in diameter.

Gold nanoparticles that act as drug delivery systems in conjugation with chemotherapeutic drugs typically range in size from 10 to 100 nm.

Drug vectorization requires greater specificity, and are synthesized within the single digit measurements ranging from 3-7 nm.

Antibacterial treatments are testing different sizes for cell type targeting; 10, 20 and 40 nm.

8.TREATMENTS:-

8.1.PHOTOTHERMAL CANCER THERAPY:-

A direct method of accessing and destroying tumour cells can be accomplished by photothermal cancer therapy or photodynamic therapy (PDT). This procedure is known to treat small tumours that are difficult to access and avoids the drawbacks (adverse effects) of conventional methods, including the unnecessary destruction of healthy tissues.The cells are destroyed by exposure to light, rupturing membranes causing the release of digestive enzymes. AuNPs have high absorption cross sections requiring only minimal input of irradiation energy. Human breast carcinoma cells infused with metal nanoparticles in vitro have been shown to have an *increase* in morbidity with exposure to near infrared (NIR). Short term exposure in vivo (4–6 minutes) to NIR had undergone the same effect. *Hirsch et al* observed that extreme heating in tumours would cause irreversible tissue damage including coagulation, cell shrinkage and loss of nuclear straining. Results of their in vivo nanoshell therapy of mice revealed penetration of the tumor ~5mm.The metal particles were tuned to high absorption and scattering, resulting in effective conversion of light into heat covering a large surface area. The *ElSayed group* studied AuNP effects in vitro and in vivo. They determined that the NIR wavelengths were converted into heat on the picosecond timescale, allowing for short exposure of CW to minimize possible exposure to healthy cells. In vitro, photothermal therapy was used in oral epithelial cell lines, (HSC 313 and HOC 3 Clone 8) and one benign epithelial cell line (HaCaT). El-Sayed *et al* found that the malignant cells that had undergone incubation in AuNPs conjugated with anti-epithelial growth factor receptor (EGFR) required half the energy to destroy a cell than a benign cell. Their material included gold coated silica nanoshells that could selectively absorb NIR waves. The particles were tuned by varying the thickness of the Au shell and changing the size of the silica core. In exposing these particles to NIR, the efficacy of Au was measured through the decrease of EFGR in oral squamous carcinoma cells.There are various biotechnological advances for in vivo delivery of drugs. To effectively target the malignant cells, the AuNPs were conjugated by polyethylene glycol, a process known as PEGylation. This masks the foreign particles from the immune system such that it arrives at its destination and increases circulation time in the system. Antibody conjugation lines the surface of the nanoparticle with cell markers to limit spread only to malignant cells. In vivo testing of mice that developed murine colon carcinoma tumour cells. They were injected with the solution of AuNPs that were allowed to spread after 6 hours. Surrounding cells were swabbed with PEG and exposed to laser treatment for detection of abnormal heating indicating areas where Au nanoshells may have gathered. The injected area was also swabbed with PEG to maximize light penetration.

8.2.ANGIOGENESIS THERAPY

Angiogenesis is a process involving the formation of new blood vessels from preexisting vessels. It involves the degradation of the extracellular matrix, activation, migration, proliferation, and differentiation of endothelial cells into vessels. It is said to play a large part in the growth and spread of cancer cells. The process of angiogenesis involves the use of both promoters and inhibitors, balancing the process by only forming new blood vessels when needed. Examples of promoters include Vascular Endothelial Growth Factor (VEGF) and fibroblast growth factor (FGF) Examples of inhibitors include Vascular Endothelial Growth Factor Receptor 1, etc. Tumor progression occurs as a result of the transition from a tumor in the dormant proliferation stage to the active stage as a result of oxygen and nutrients. This active stage leads to a state of cellular hypoxia, which causes an increased regulation of pro-angiogenesis proteins such as VEGF. This results in the spreading of inflammatory proteins and cancer cells alongside the newly created blood vessels.

AuNPs have the ability to inhibit angiogenesis by directly coordinating to heparin binding growth factors. They inhibit phosphorylation of proteins responsible for angiogenesis in a dose dependent matter. At concentrations 335-670 nM, almost complete inhibition of phosphorylation was observed. As a consequence of angiogenesis, rheumatoid arthritis has been found to develop due to the greater ability to spread inflammatory proteins. Through the inhibition of angiogenesis, the reduction of rheumatoid arthritis is prevalent. In addition, angiogenic inhibitors have a critical limitation due to the instability of biological conditions and high dosage required. To counter this, an emerging strategy for the development of therapies targeting tumor-associated angiogenesis through the use of nanotechnology and antiangiogenic agents was developed,

known as anti-angiogenic therapy. This approach solved the limitation instability by speeding up the delivery of angiogenesis inhibitors. Gold nanoparticles display anti angiogenic properties by inhibiting the function of pro-angiogenic heparinbinding growth factors (HG – GFs), with prime examples being the vascular endothelial growth factor 165 (VEGF165) and the basic fibroblast growth factor (bFGF) - both of which are pro-angiogenic promoters. Studies by Rochelle R. Arvizo, *et al.* have shown that the use of AuNPs of various size and surface charge plays an important role in its inhibitory effects. In today's biological fields, the use of nanotechnology has allowed for the indirect use of AuNPs to deliver DNA to mammalian cells; thereby reducing tumor agents and increasing efficiency of electron transfer by modulating the activity of glucose oxidase. Current ongoing research by the Mayo Clinic laboratories includes the examination of AuNPs as messengers to deliver reagents capable of manipulating the angiogenic response in vivo.[14] Current angiogenic inhibitors used today which are approved by the USFDA to treat cancer is Ayastin, Nexavar, Sutent and Affinitor.

8.3.ANTI BACTERIAL THERAPY:-

Gold nanoparticles are used as bacteria targeting particles in antibacterial therapy.

The therapy targets bacteria with light absorbing gold nanoparticles (10 nm, 20 nm, 40 nm) conjugated with specific antibodies, thus selectively kill bacteria using laser.

Studies has shown the effectiveness of this method on killing Staphylococcus aureus, which is significant human pathogen responsible for a wide range of diseases such as skin and wound infections, toxic shock syndrome, septic arthritis, endocarditis, and osteomyelitis.

In this system, the bacteria damage is caused by inducing strong laser which leads to overheating effects accompanied by the bubble-formation phenomena around clustered gold nanoparticles.

Killing efficiency depends on local overheating effects accompanied by the bubbleformation phenomena, the bubble formation would enhance the PT killing effect.Better heating efficiency results from an enhanced ability to confine the nanosecond laser-pulse within the nanocluster's size. Overlapping of bubbles from different nanoparticles within the nanoclusters decreases the bubble-formation threshold.

8.4.RADIOFREQUENCY THERAPY:-

X-ray radiography procedures involves the diagnosis of cancer cells through the process of image acquisition. These techniques rely on the absorption of x-rays on the exposed tissue in order to improve image quality. In certain radiological procedures such as Radiofrequency therapy, a contrast agent is injected into the targeted cancer tissue and result in increased x-ray attenuation.

Radiofrequency therapy treatment involves the destruction of tumor cancer tissue cells through the differential heating of cancer tissue by radiofrequency diathermy. This differential heating is a result of the blood supply in the body carrying away the heat and cooling the heated tissue.

Gold nanoparticles are excellent absorbers of x-rays, due to its high atomic number of 197Au. This allows for a higher mass of the element, providing for a greater area of x-ray absorption. By acting as a contrast agent and injected into cancerous tumor cells, it would result in a higher dose of the cancerous

tissue being exposed during radiotherapy treatment.

8.5.DRUG VECTORIZATION:-

Another way in which AuNPs can be used in cancer therapy is as agents for targeted drug delivery. Research shows that AuNPs can be easily functionalized and conjugated with a variety of molecules, including chemotherapeutic drugs such as Doxorubicin. One major complication with the current methods of treating cancer with chemotherapy is that treatment is not optimized to specifically target cancer cells and the widespread distribution of chemotherapeutic drugs throughout the body can cause harmful side effects such as naseua, hair loss, and cardiotoxicity.Since many of the characteristics of AuNPs allow them to target cancer cells specifically and accumulate within tumor cells, these molecules can act as tumor-targeting drug delivery systems. Once within the tumor microenvironment, these complexes dissociate and release the chemotherapeutic, allowing the drug to take effect and eventually cause apoptosis. Gold nanoparticles have their advantages in drug vectorization. They can pack several different sizes and types of dendrimers and several different types of ligands in order to effectively treat different types of cancers. For example, research shows that 80~90% of breast cancer's tumor cells have estrogen receptors and 60~70% of prostate cancer's tumor cells have androgen receptors. These significant amount of hormone receptors play a role in intermolecular actions. This role is now used by targeting and therapeutic ligands on gold nanoparticles to target tissue selective anti-tumor drug delivery. In order to have multiple targeting and therapeutic ligands bind with gold nanoparticles, the gold nanoparticles must first undergo polymer stabilization. Then, anti-estrogen molecules with thiolated PEG are bound to gold nanoparticles via Au-S bonds, forming thiolate protected gold nanoparticles.

Docetaxel is packed into PEGylated gold nanoparticles Docetaxel is an antimitotic chemotherapy medicine which PEGylated gold nanoparticles showing great performance in clinical trial. Docetaxel was approved by FDA, to treat several different kinds of cancer. i.e. breast cancer(include locally advanced or metastatic).

9.PROGRESS:-

1.Organo gold compounds has been prepared that are sufficiently stable under physiological conditions and are promising candidates for pharmacological testing as cytotoxic agent.

2.Gold is highly resistant to bacteria and can be used to prevent the growth in infections.

3.Gold nanoparticles are used in treatment of rheumatoid arthritis and other auto immune diseases.

10.ADVERSE EFFECTS AND LIMITATIONS:-

10.1.SHAPE

Depending on the shape of the molecule, the absorbance will vary, i.e. spherical particles will absorb wavelengths in the NIR region with a relatively low absorbance compared to long rods.[24] *Chan et al* observed that 50 nm spherical nanoparticles were taken up more efficiently than both larger and smaller particles of the same shape. In regards to size, the spheres were taken up more efficiently than the rods.[25] Ability of greater uptake of nanoshells into the cell will localize in the perinuclear membrane and accumulate to deliver toxic effects.

10.2.CHARGE

Electrostatic interactions were also investigated by Rotello *et al* by conjugating AuNPs with anionic and cationic functional groups. Their results showed that toxicity was more established in AuNPs conjugated with cationic functional groups as a consequence of electrostatic interactions with the anionic cell membrane.

10.3.CONCENTRATION

The concentrations of gold nanoparticles in biological systems for practical usage range from 1-100 nanoparticles per cell. High concentrations may lead to adverse effects for cell structure and function, which may not appear non-toxic in assays but preparation of the particles have been found to produce abnormal effects in the cell. If large concentrations quickly clear the blood vessels, the nanoshells may accumulate in major organs (mainly the liver and spleen). Residual concentrations of these particles were also found in kidneys, lungs, muscle, brain, and bone of mice after 28 days. The concentration of the solution injected intravenously 2.4*1011 nanoshells/mL. Even without complete clearance from the system, the nanoshells did not cause any physiological complications in the mice. Su *et al* observed a correlation with the concentration of Au3Cu and cell damage. Cells were incubated in concentrations of 0.001 and 200 mg mL −1 Au3Cu. They concluded a 15% cell viability and dose dependent cell damage. Reduction in cell viability was detected in vivo experiments; also related to dosage. Cytotoxicity is not a major concern in the usage of AuNPs, as they localize in the vesicles and cytoplasm as

opposed to the nucleus. Thus, no complications spawned due to their aggregation in these parts of the cell.

10.4.HEATING

Two key factors to consider when irradiating gold nanoparticles in cancer cells are the lattice cooling rate and lattice heat content. The lattice cooling rate is how fast heat in the particle is distributed to its surroundings. If the cooling rate for a particle is too low, the lattice heat content can be increased with moderate energy radiation (40 μJ/fs with 100-fs laser at 800 nm) to the point where gold nanorods can be melted to create spherical nanoparticles which become photothermally inactive. This decomposition has been shown using gold nanorods coated with phosphatidylcholine ligands in HeLa cells using a pulsed laser and were no longer useful for treatment due to their low NIR radiation absorbance. High energy laser pulses have also been shown to fragment nanorods into smaller particles. While these structural changes induced by laser pulses could be used to deactivate the photothermal effects of these particles after treatment, the resulting spherical particles or other particle fragments could lead to complications during or after treatment when gold nanoparticles are used for clinical treatment and imaging of cancer cells. A limitation of photothermal chemotherapy using gold nanoparticles involves the choice of laser when conducting treatment. Pulsed lasers offer very selective treatment of cancer cells within a small, localized area, but can lead to potential destruction of particles and have a low heating efficiency due to heat lost during the single pulse excitation. Continuous wave lasers have a higher heating efficiency and work better in heating larger areas with lower risk of destroying the nanoparticles being heated. However, treatment with continuous wave lasers are much longer compared to treatment with a pulsed laser. A limitation of photothermal therapy with respect to the laser used is the depth of the tumor being treated. Most lasers used to induce tumor ablation using gold nanoparticles can only reach several centimeters into soft tissue, making it impossible to reach tumors farther in the body. Finding a way to carry out therapy in cells farther into the body without damaging surrounding cells is essential to making this technique viable as a cancer treatment in future.

11.CONCLUSION:-

Gold Nanoparticles have many properties that demonstrate their potential use in cancer diagnosis and therapy. They can be easily synthesized by chemical and biological methods without much need of sophistication. Their size and enhanced permeability and retention effect enables easy penetration and accumulation at tumor sites. GNPs have a high atomic number, which leads to greater resonant absorption of energy and provides greater contrast than standard agents. Further, GNPs are able to bind proteins and drugs targeted to cancer specific cell surface receptors.

They can be effectively employed in photothermal therapy due to surface plasmon resonant light absorption when exposed to the light of specific energy producing heat. Owing to these properties, there is great deal of excitement and interest among research community worldwide. However, issues related to evaluation of toxicity and mutagenic potential, large scale production for clinical use and implementation of standards for characterization and pre-clinical testing have to be addressed.