

# Topic H: Heavy Metals in Medicine

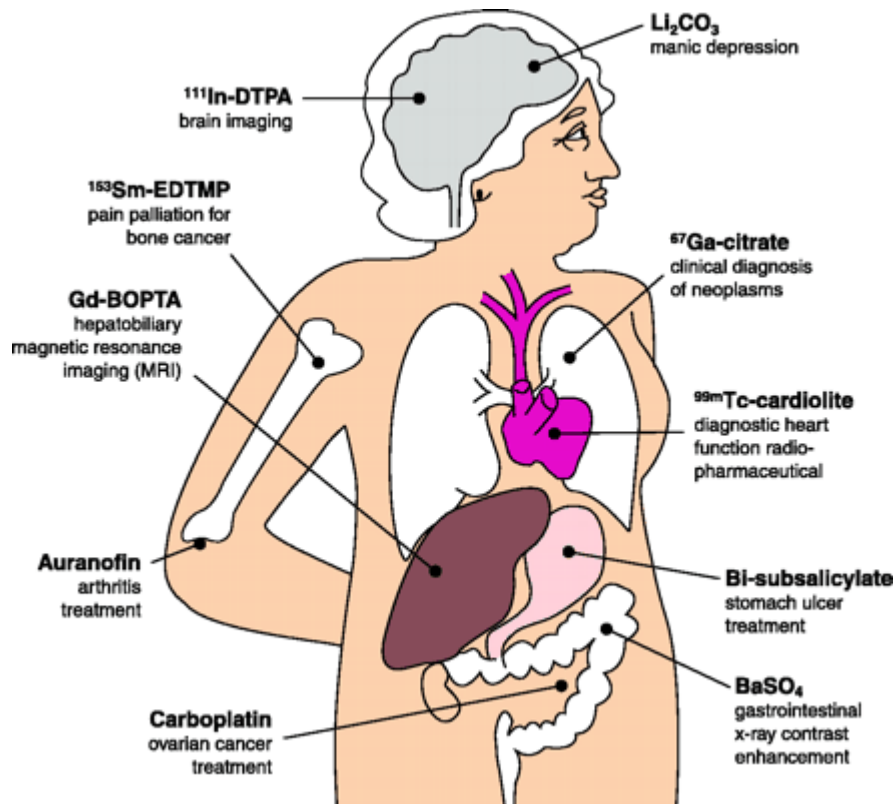
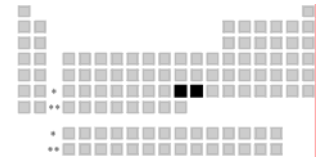


Figure H.1 Metals in diagnosis and therapy of different human pathologies

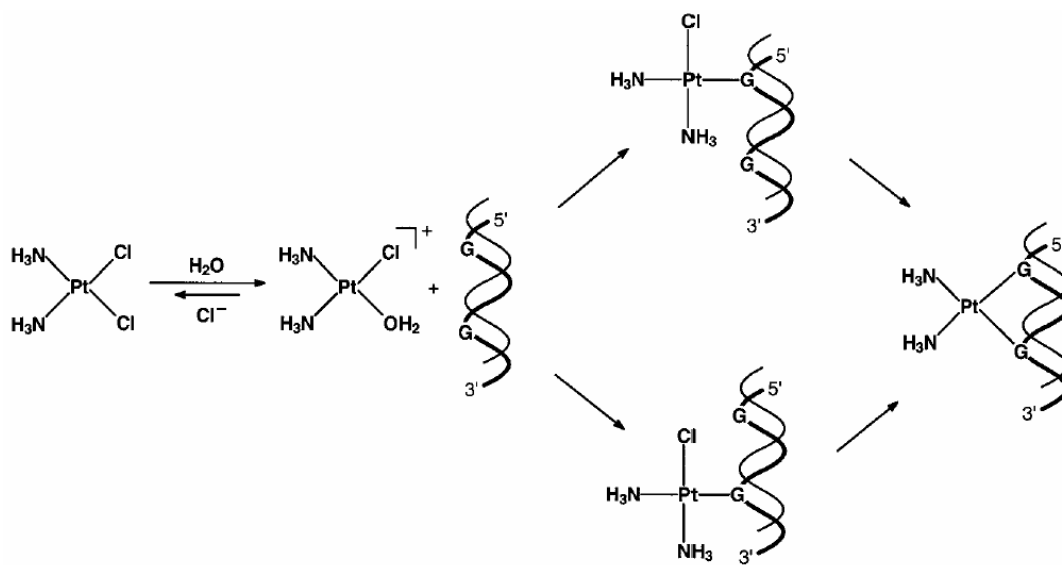


Figure H.2 Mechanism of reaction of cis-platin with DNA

## Topic H: Heavy Metals in Medicine

A variety of heavy metals are used in medicine; some we have already covered, see *Figure H1*.

### Platinum anti-cancer drugs

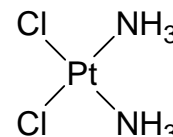
Pt(NH<sub>3</sub>)<sub>2</sub>Cl<sub>2</sub>: 1844 “Peyrone’s chloride”

1893: Werner elucidated structure, showed existence of two forms, *cis*- and *trans*- (Nobel Prize 1913 for work on coordination complexes)

1960s: Barrett Rosenberg was investigating effect of electrical current on cell growth of *E. coli*

Found that cells elongated 300×; effect persisted after current switched off

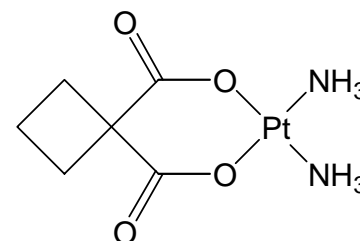
A compound released from Pt electrodes responsible for effect; shown to be *cis*-platin:



Tests showed suppression of cell division but not other growth processes; tested on cancer cells – found to be effective and approved for drug use in 1978

1985 – Rosenberg introduces carboplatin; reduced kidney and neurotoxicity:

Pt drugs kill cells by cross-linking DNA via binding to a pair of guanine bases on adjacent DNA strands, bending the helix by 35-40° and partially unwinding the double helix:



*Figure H2*

Mortality from testicular cancer in young men has dropped from almost 100% to less than 10% in the past 25 years.

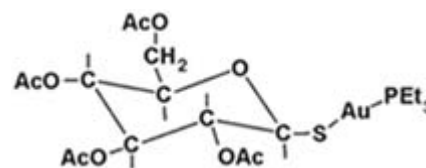
*Read extract from “It’s not about the bike” by Lance Armstrong.*

### Gold anti-arthritis drugs

Gold has been used in medicine since 2500 BC (Chinese) “chrysotherapy”.

A number of drugs are effective in the treatment of arthritis but mechanism of action is not well understood, e.g. Auranofin:

Both P- and S- ligands are “soft”, well matched for Au<sup>I</sup> and making the drug stable enough to be taken orally; the acetate groups are hydrolysed off in the body and the phosphine oxidized off as O=P<sub>3</sub>. Gold becomes bound to thiol groups of blood proteins.



### Silver

Ag<sup>+</sup> is deadly to both bacteria and viruses, and may make a return to hospitals as they kill antibiotic-resistant strains of infection. 10 ppb will sterilize water. If ingested, HCl in stomach ppt<sub>s</sub> Ag<sup>+</sup> as insoluble AgCl; recent commercial product protects the Ag<sup>+</sup> in a polymer which releases ions slowly.