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Chemistry in Medicine and Healthcare

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Abstract: The chemist's most impressive contribution to medicine has been his expansion of the physician's selection of drugs. Drugs and medicines are Chemicals used medically for treating diseases and injuries. Drugs carry the added connotation of narcotics and addiction. The most lucrative field in organic chemical product is that of pharmaceutical products. Vitamins hormones antibiotics, anaesthetics, antiseptics and germicides are all products of organic chemistry. Most of the rather substantial increase in human life expectancy in recent years has been attributed to the development of new medicinal agents. Medicinal chemicals are available to treat various human diseases. There are antibacterial, antiviral, antifungal, antidepressants and anticancer and anti-AIDS drugs. There are medicines to treat stroke and heart attack, ulcers, parasites, and various hormone deficiencies.

Keywords: Medicine, health care, chemistry, diagnosis

CHEMISTRY AND MEDICAL DIAGNOSIS

Modern physician depends heavily on laboratory techniques:

- (i) In analysis of micro-samples of blood, serum, urine, etc.
- (ii) to identify cases of drug abuse and
- (iii) to identify infectious microorganisms by "fingerprinting" their characteristic metabolic products.

Chemistry plays a vital role in clinical laboratory analyses diagnostic Radiopharmaceuticals, biomedically important plastics and medical education and research. The modern physician depends heavily on laboratory results in making the critical decisions of diagnosis and treatment. Through the years, the medicines has become less of an art and more of a science; the hospital clinical laboratory has been at the forefront of that transition. Furthermore clinical laboratory science has increasingly become applied Chemistry. Whether the measurements of biological, chemical, and physical Phenomenon within the body is done by classical 'wet' test tube methods or by complex instruments, it is still chemistry in action.

The combination of sophisticated instruments used in tests has provided Powerful new tools for the separation and identification of biologically Important molecules present in micro-samples of blood, serum, and urine. For example, it is now possible to identify rapidly the particular drug of Abuse in cases of overdosing, to monitor blood levels of antidepressants and cardiovascular drugs, and to identify infectious microorganisms by "Fingerprinting" their characteristic metabolic products. Earlier methods of Pinpointing the particulars drug of an overdose or the particular bacterium of an infection were so slow and tedious that treatment decisions were often critically

delayed. Areas of radio immuno assay (RIA), X-ray films and magnetic resonance imaging (MRI) have revolutionized the diagnostic Procedures in the field of medicine and health care.

DRUGS- THE CHEMICAL COMPOUNDS

Chemistry plays a vital role in the development of new drugs. A drug has

Three names:

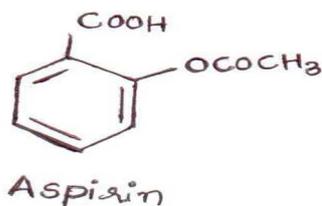
- (i) Brand name (valium)
- (ii) Chemical name (7, chloro-1, 3-dihydro-1methyl-5-phenyl-2 H-1, 4-benzodiazepin-2-one)
- (iii) Generic name (diazepam)

There are various types of drugs specific for curing different diseases.

PAIN- RELIEVING DRUGS

These are classified as analgesics or painkillers. Aspirin, the trade name of acetylsalicylic acid, is the leading commercial pain reliever, inexpensive and easily available. More aspirin is taken than any other single medication of any kind. Aspirin acts as an analgesic (to relieve pain), as an antipyretic (to lower fever), and as an anti-inflammatory agent (to reduce inflammation). It prevents blood clotting and is highly recommended for prevention of heart attack.

It is also a drug for treatment of rheumatoid arthritis in the form of buffered aspirin commonly known as 'Bufferin'. The buffered aspirins consist of a combination of aspirin and one or more bases such as magnesium hydroxide or carbonate, and aluminium hydroxide, which increase rates of disintegration and absorption of aspirin tablets. Those who are allergic to aspirin or who find that it produces stomach disorders, acetaminophen (active ingredient of Tylenol) provide relief. Ibuprofen is another drug for treatment of inflammation and fever.



ASPIRIN: It is prepared by acetylating salicylic acid (O-hydroxy-benzoic acid) with Acetic Anhydride (or) Acetyl chloride.

Antacids-Drugs for Stomach Upset

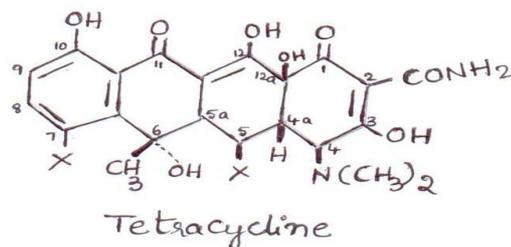
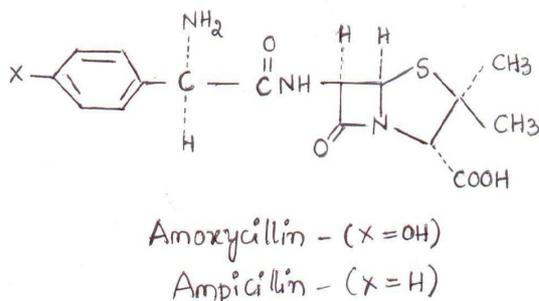
The gastrointestinal tract is subjected to several drugs. Stomach upset and heartburn result from production of too much hydrochloric acid. Antacids (bases) are taken to neutralize excess hydrochloric acid in the stomach, which causes "heartburn". Aluminum hydroxide and calcium carbonate are the common ones.

The laxatives work by either irritating or lubricating the intestine and these are usually lubricants (mineral oils), feces, softeners, epsom salt (magnesium sulphate), and organic compound, which are bowel irritants. The antidiarrhoeals are also widely used. The toxic materials from the intestine are effectively absorbed by kaolin clay or charcoal.

Antibiotics-Drugs to Combat Infections

Microorganisms cause most of the infectious diseases. The well-known remedies are provided by: synthetic sulpha-drugs (sulphanilamide, penicillin the first natural antibiotic) streptomycin, tetracycline, Terramycin and aureomycin.

When the sulpha-drug gets built into an enzyme, the enzyme is so badly misshapen that it cannot perform its normal metabolic task. The modern antibiotics are themselves produced by and extracted from microorganisms. They stop growth of disease-causing microbes in various ways: penicillin by preventing formation of bacterial cell walls, tetracycline and streptomycin by preventing protein synthesis and actinomycins by interfering with bacterial DNA production.



Ampicillin: Chemically ampicillin is (6R)-6-(α -phenyl-D-glycylamino) penicillanic acid.

Amoxycillin : is different from Ampicillin in possessing P-hydroxy function on the benzene nucleus.

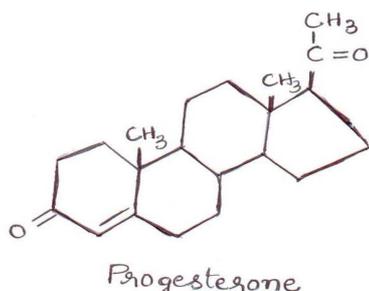
Tetracycline: Chemically tetracycline is (4S,4Ar,5Ar,6S,12As) 4-dimethylamino-1,4,4a,5,5a,6,11,12a-octahydro-3,6,10,12a-penta hydroxyl-6-methyl,1,11 di oxo naphthacene,2,carboxamide.

Hormones-Birth Control Pill

Of the many sex hormones, the female estrogens are of great interest, since they (and related compounds) are used in oral contraceptives. Progesterone is an effective birth control drug (injected) in addition to norlutin. Which is administered orally (pill).

Chemicals known as hormones control our bodies, which make a boy a boy or a girl a girl. Hormones are chemical messengers, which direct how your body grows and maintains itself. For example, men usually have deep voices and hair on their faces, whereas women have higher pitched voices and no hair on their faces. Hormones control both of these characteristics. For men, testosterone and androstenedione are the most abundant. For women, estradiol and estrone are the most important. They are almost identical, but what a difference they make for men and women. The reason they look so similar is that they all come from the same starting hormone, progesterone.

Ordinary diabetes result when the body cannot oxidize sugar fast enough, and shows up as excess glucose in blood and urine. Diabetes cannot usually be cured, but giving the diabetic the undersupplied hormone, insulin, can control it practically indefinitely. The thyroid hormones are pacemakers for the metabolic system, which Runs too fast if too much thyroxine is secreted; this is remedied either by antithyroid drugs or by surgery. Cortisol, cortisone (two of the adrenal Cortex hormones), and structurally similar compounds are sometimes used To treat (but not often to cure) a group of diseases that includes arthritis.



PROGESTERONE: Progesterone is the main hormone which is reduced by corpus luteum and the placenta. It is a pregnane derivative which is having double bond between position 3&20. It is chemically 4-pregnene-3, 20-dione.

STIMULANTS AND DEPRESSANTS

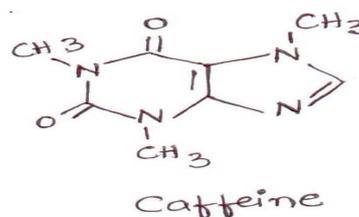
“The uppers”

These are chemicals, which can affect the mind and thus the perceptions of reality. Some such substances are: cocaine, amphetamine, nicotine and MDMA (Ecstasy). These elevate blood pressure, suppress appetite, decrease sense of fatigue, and increase confidence and alertness. Caffeine is an alkaloid that occurs in coffee beans and in tea leaves. It stimulates the central nervous system and heightens a sense of awareness. Decaffeinated coffee, of course, contains virtually none. Caffeine is added to cola drinks at a concentration of about 35 to 55 mg per 12-oz bottle. Nicotine is a highly poisonous alkaloid that occurs in tobacco leaves. There is growing recognition of health hazards posed by nicotine cigarette smoker and also to non-smokers who inhale second hand smoke generated by smokers. The synthetic amines ephedrine and amphetamine, used as decongestants for the nose and sinuses, are closely related in structure and effects, but the amphetamines also stimulate the central nervous system and are sometimes misused.

“The downers”

Ethyl alcohol (alcohol) is a depressant because it depresses the function of the brain that controls thinking and coordination. In high doses, it produces drowsiness and sleep. Alcohol is an addictive drug since it can cause serious withdrawal symptoms. Alcohol intoxication is responsible for approximately half of the traffic deaths around the world. When consumed in large quantities, alcohol can produce varied ill effects:

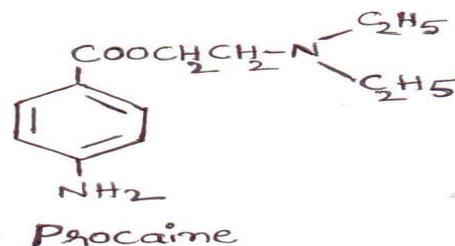
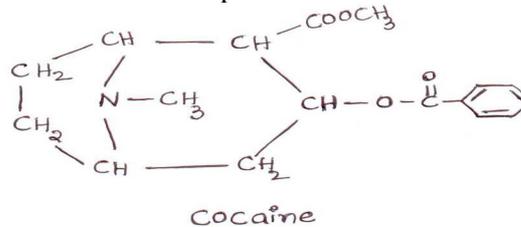
Amount (Mg alcohol / 100 ml blood)	Effect
50-150	causes lack of coordination
150-200	causes intoxication
300-400	causes unconsciousness
500 mg or more	may be fatal



Caffeine: Chemically caffeine is 1,3,7-trimethylxanthine, theophylline, 1,3,7-dimethylxanthine.

DRUG AFFECTING THE CENTRAL NERVOUS SYSTEM

The purpose of surgical anaesthesia is to prevent a patient from experiencing pain. Now, the anaesthetist may choose among half-a-dozen simple compounds usually used along with a muscle relaxant injected into a vein. Two common local anaesthetics are procaine and cocaine (from cocoa). Sedative-hypnotic drugs depress the central nervous system and are often used to produce sleep or relieve anxiety. One well-known group of sedatives consists of cyclic nitrogen compounds, especially the barbiturates, thalidomide. They are used to induce sleep.



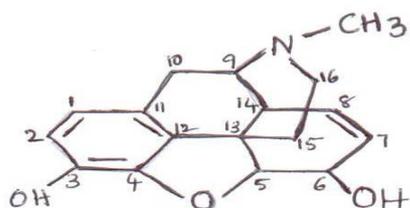
Cocaine: Chemically, cocaine is benzoylmethylecgonine. But ecgonine is a derivative of tropane which is having a carboxylic group at position 2 & hydroxyl group at position 3. Therefore, cocaine is an ester of benzoic acid having a nitrogenous alcohol.

PROCAINE: It is a synthetic agent which is superior to cocaine. Chemically, it is diethylaminoethyl p-aminobenzoate.

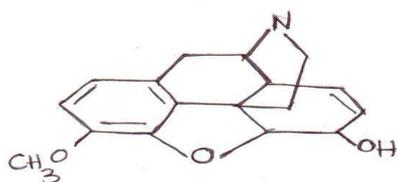
NARCOTICS

A narcotic is a mind-altering drug that produces a stupefying dulling effect and that induces sleep and generally numbs the senses. Alkaloids are basic bitter-tasting, nitrogen-containing compounds that are found in plants and that produce physiological reactions of various kinds and intensity. Morphine is the major alkaloid of opium which is the dried sap of poppy and contains several narcotic compounds. Morphine is a powerful narcotic as well as a cough suppressant but is highly addictive.

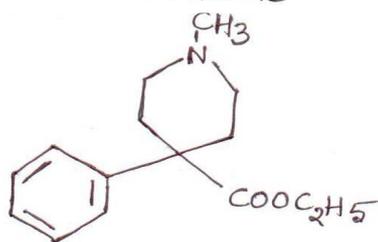
Codeine is another opium alkaloid, less potent analgesic than morphine, and yet one of the most powerful cough suppressants, most common drugs used on the respiratory system. Pethidine is also used as a narcotic. These Narcotics are very potent painkillers but have to be used cautiously because both tolerance (need for larger and larger doses) and dependence on the Drug can develop at a frightening rate. Heroin marijuana Indian hemp and certain mushrooms belong to this category as well.



Morphine



Codeine

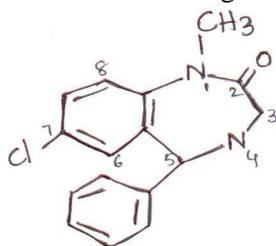


Pethidine

PETHIDINE: Pethidine is a synthetic compound which is a derivative of piperidine chemically it is 4-ethoxy carbonyl-1-methyl-4-phenyl piperidine. Its hydrochloride is official compound.

TRANQUILLIZERS

Tranquillizers calm tension and anxiety but do not cause sleep. The kind Of drugs available for the treatment of mental pain and its effects are the Tranquillizers and the antidepressants. These drugs calm a patient without making the person tired. Some of the most popular names are librium equanil ,miltown and valium (diazepam). Prozac (fluoxetine) holds the lead among the antidepressants.



Diazepam

DIAZEPAM:It is having 1,3 dihydro-2H-1,4-benzodiazepin-2, one skeleton which is having substitutions of methyl at position 1, phenyl at position 5 and chloro at position-7.

Conclusion:

Chemistry in its various facets along with its related disciplines from the Physical and biological sciences, has been necessary for pharmaceuticals. It is not easy to classify any individual procedure or reaction as solely pharmaceutical. An interesting example is that the process of converting of alcohol into ether, which is an excellent general anaesthetic. May be modified to produce ethylene which find use as an industrial chemical. Similarly, the procedure for hydrogenating of adiponitrile to diaminohexane, which is a synthetic fibre intermediate, may be used for converting streptomycin into dihydrostreptomycin. Drug standardization uses several techniques and procedures of analytical Chemistry.

Different chemicals find use as drugs. Physicians must have proper knowledge of drugs and their actions so that they should carry out their duties in a proper manner. Antiseptics such as sodium hypochlorite, pain relievers such as morphine, and pethidine, antibiotics such as penicillin and streptomycin are common drugs which are widely used every day. Proteins are used for the body building, vitamins are used for treatment of deficiency diseases, fluorides are added to drinking water so as to stop tooth decay. Thus, it is evident from the above examples that chemistry has been intimately linked with pharmacy. Hence a sound knowledge of the fundamentals of chemistry has been required for understanding and following the recent development in medicine and Pharmacy.

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