Criteria necessary for accreditation of the subject "General pharmacology and toxicology"

1) Mandatory classes:
   - Course pharmacology and toxicology, 6th semester, Wed. 9:15-10:45 am+ Fri. 10:15-11:45

2) Concordant class
   - Lecture pharmacology and toxicology, 5th and 6th semester, Tue.-Thurs. 8:15-9:00 am

3) Record of achievement:
   - Exam at the end of the 6th semester

4) Learning objective: pharmacology and toxicology

1. General pharmacology and toxicology

1.1 Pharmacodynamics

• Drug-effects [(non-) receptor transmitted, reversible und irreversible]
• Signaling pathways for membrane and intracellular receptors
• Dose-effect curve (maximum effect, potency, receptor reserve)
• Agonists, partial agonists, inverse agonists
• Antagonists (reversible, irreversible, competitive, non-competitive)
• Plasma concentration-effect-correlation, Hysteresis
• Pharmacodynamic interactions
• Pharmacodynamic tolerance und sensibility
• Drug-dependency und –addiction

1.2 Pharmacokinetics

• Resorption (mechanisms, significance of physicochemical characteristics)
• Distribution (mechanisms, significance of physicochemical characteristics)
• Elimination (systemic, pre-systemic)

- Elimination by expulsion (renal, biliary, enteral etc.) - Elimination by metabolism (hepatic, enteral etc.)

Phase-I- und Phase-II-metabolism

Pharmacogenetics
• Pharmacokinetic variables

- Systemic availability (''Bioavailability '')
- Elimination half-life, terminal half-life

- Plasma (Blood)-Clearance (total, renal, extra renal clearance) – Distribution compartments

• Culminating, „deep“ compartment
• Initial dose und maintenance dose
• Linear und non-linear Kinetic
• Relation between pharmaceutical effects, time, and effect duration
• Pharmacokinetic interactions

• Pharmacokinetic tolerance

1.3 General toxicology

• Areas of toxicology
- Drug toxicology
- tissue toxicology
- food toxicology
- environmental toxicology

• Exposition and dose-effect-correlation
- acute, chronic
- local, systemic
- Significance of the intake path (metabolic activation/inactivation) - dose-effect-correlation

• Quality of toxic affects
- Acute toxicity
- Chronic toxicity
- Teratogenicity, Embryo toxicity
- Carcinogenicity
- Immunotoxicity
- Fertility problems

• Principals risk assessment
- Determining toxicity (acute, subacute, subchronic, chronic)
- Determining kinetics and biotransformation
- Mutagenicity examinations
- Carcinogenicity examination
- Tests for reproductive toxicity (Fertility, embryotic harm)
- evaluation concepts with determination of norm-intervals (ADI, MAK, BAT, TRK)

• Human biomonitoring (HBM)
- Exposure monitoring (internal dose); effect monitoring
- Foreign body spectrum; advantages and limits of HBM
- Matrices (blood, urine, saliva)

- evaluation (biologic limit values (BLV, human biomonitoring values I and II)
- risk assessment by utilizing the internal dose of physical properties
- cases

1.4 Drug-development

• Development
• Approval and monitoring

1.5 Dogmatic treatment areas

• Phytotherapy
• Homeopathy
• Anthroposophy therapy

2. Specific Pharmacology and toxicology

(all pharmaceutical groups include the following aspects: typical active ingredients, mechanism of action, effects, Pharmacokinetics, usage and contraindications, side effects and interactions)

2.1 Pharmacology des autonomic nervous system

2.1.1 Sympathetic nervous system

• Synthesis, storage, release and inactivation of Noradrenalin and Adrenalin
• α- und β-Adrenoceptors and their subtypes

- Receptor-distribution in the organism; synaptic localization
- Signaling pathways; sensibilisation und desensibilisation – transmitted effects

• Drugs with affects on the noradrenergic transmission by
- Synthesis-inhibition and production of false transmitters (α-Methyldopa)
- Inhibition of vesicular storage (Reserpin)
- Inhibition or increase of transmitter release (Clonidine, Moxonidine; α2-adrenoceptor-agonist and –antagonists, Guanethidine, indirect sympathomimetics)
– Inhibition of transmitter-inactivation (inhibitors of re-uptake; inhibitors of MAO-A, MAO-B or COMT)

• Drugs with effects on α-adrenoceptors
- Subtype-selective and non-selective agonists (i.e. Phenylephrine, Oxymetazoline)
- Subtype-selective and non-selective antagonists (i.e.Phentolamine, Prazosin)
- partial agonists (i.e. ‘‘mothercorn’’ alkaloids)

• Drugs with effects on β-adrenoceptors
- Subtype-selective and non-selective agonists (i.e. Isoprenaline, Fenoterol,

Salmeterol)
- Hybrid agonists with effects on α- und β-adrenoceptors (i.e. Dobutamine)
- Subtype-selective and non-selective antagonists (i.e. Atenolol, Propranolol, Metoprolol, Bisoprolol, Esmolol)
- Hybrid antagonists with effects on α- und β-Adrenoceptors or NO- release (i.e. Carvedilol, Nebivolol)
- partial agonists (i.e. Pindolol)

2.1.2 Parasympathetic nervous system and other cholinergic systems

• Synthesis, storage, release and inactivation of Acetylcholine
• Cholinoceptors (muscarinic, nicotinic) and their subtypes

- Distribution in organisms, synaptic localizations
- Signaling pathways, sensibilisation und desensibilisation –transmitted effects
• Drugs with effects on the cholinergic transmission by inhibition
- Transmitter-release (Botulinum-Neurotoxin; Loperamid)
- Transmitter-inactivation (Cholinesterase-Inhibitors)

• Drugs with affects on muscarinic cholinoceptors
- Agonists with tertiary or quatarnary nitrogen (i.e. Pilocarpine, Carbachol)
- Antagonists tertiary or quatarnary nitrogen (i.e. Atropine, Butylscopolamine)

• Drugs with effects on nicotinic cholinoceptors of the muscular type
- Agonists (depolarizing muscle relaxants: Suxamethonium)
- Antagonists (non- depolarizing muscle relaxants: i.e. Atracurium, Rocuronium, Pancuronium, historically: Tubocurarine)
- Suggammadex

• Drugs with effects on nicotinic cholinoceptors of the neuronal type
- Agonists on ganglion type nicotinic receptors (Nicotine)
- Antagonists on ganglion type nicotinic receptors (Ganglionic blockers)

• Addendum: myotropic muscle relaxants (Dantrolene)

2.2 Pharmacology des central nervous system

2.2.1 Amino acid -Transmitters of the CNS

• GABA (GABAergic neuron systems, GABA-synapsis, GABA-receptors)
• Glycine (Glycinergic neuron systems, Glycinergic-synapsis, Glycine-receptors)
• Glutamate (Glutamatergic neuron systeme, Glutamate-Synapsis, Glutamate-receptors)

2.2.2 Narcotics

• Inhalation narcotics (Gases i.e N2O, Xenon, vapours: i.e. Isoflurane, Sevoflurane, Desflurane)
• Injection narcotics (Barbiturates, Ketamine, Etomidate, Propofol, Benzodiazepine, Dexmedetonidine)

2.2.3 Hypnotics/Anxiolytics (Tranquilizers)

• Benzodiazepines (BZD-receptor on the GABAa-receptor chloride ion channel complex
- Agonists for the BZD-receptor with short-and long-term effects
- Antagonists for the BZD-receptor (Flumazenil)
• Zopiclone, Zolpidem, Zaleplon
• Chloral hydrate and Clomethiazole
• Anxiolytics and sedatives from different drug groups: Opipramol. Trimipramine
• Antihistaminies with hypnotic effects (i.e. Promethazine, Diphenhydramine)
• Addendum: central muscle relaxants
- Benzodiazepines (i.e. Tetrazepam)
-GABAb-receptor agonists (Baclofen)

2.2.4 Antiepileptics (Anticonvulsants)

• Antiepileptics with effects on the GABAergic transmission
- Substances with effects on the GABAa-receptor (BZD, Phenobarbital, Topiramate)
- Substances with effects on GABA-inactivation (Valproate, Vigabatrin, Tiagabine)
- Substances with effects on the GABA-releasing vesicle protein SV2A (Levetiracetam)
• Antiepileptics with Na+ -channel-blocking effect (Carbamazepine, Phenytoin, Loamotrigine, Valproate)
• Antiepileptics with CA2+-channel-blocking effect (Pregabalin, Gabapentin, Ethosuximide, Topiramate, Valproate)
• Antiepileptics with effects in the glutamatergic transmission (i.e. Lamotrigine, Valproate)
• Substances with effects on Glutamate-receptors (i.e. Topiramate)

2.2.5 Anti-Parkinson medication

• Dopamine as a CNS-transmitter
- Dopaminergic neuron systems, dopaminergic synapses
-Dopamine-receptors, their signaling pathways and transmitted effects
• Levodopa (Combination with Dopa Decarboxylase-Inhibitors (i.e. Benserazide))
• Dopamine-receptor agonists (Pramipexole, Ropinirole, Apomorphine, historically ergoline-derivatives (i.e. Lisurid, Bromocriptine))
• COMT-inhibitors (Entacapone, Tolcapone)
• MAO-B inhibitors (Selegiline, Rasagiline)
• Muscarinics receptor- antagonists (i.e. Biperiden, Trihexyphenidyl, Metixen
• NMDA antagonists (Amantadin, Budipin)

2.2.6 Antipsychotic medication

• First-generation antipsychotics
- Phenothiazines (i.e. Chlorpromazine, Levomepromzine, Perphenazin
- Thioxanthenes (i.e.Chlorprothixen, Flupentixol)
- Butyrophenones (i.e. Haloperidol, Benperidol, Melperone, Pipamperon)
- Diphenylbutylpiperidines (i.e. Fluspirilene, Pimozide)

• Second-generation antipsychotics (i.e. Clozapine, Olanzapine, Quetiapine, Risperidone, Aripiprazole)

2.2.7 Antidepressants

• Mechanism of drug effect
• Non-selective monoamine-reuptake-inhibitors
- Tricyclic and tetracyclic AD (Imipramine, Clomipramine, Nortriptyline, Amitriptyline, Doxepin, Maprotiline)
- Venlafaxine, Duloxetine, Bupropion
• Selective Serotonin-reuptake-inhibitors (Fluotexine, Citalopram, Paroxetine, Sertralin)
• Selective noradrenaline-reuptake-inhibitors (Reboxetine)
• a2-adrenoceptor-antagonists (Mirtazapine, Mianserin)
• Melatonin-receptor agonists (Agomlatine)
• MAO-inhibitors (Tranylcypromine, Moclobemide)
• St. John´s Wort (Hyperforin)

2.2.8 Mood-stabilizers

• Lithium carbonate
• Carbamazepine and Valproate

2.2.9 clinically used psychostimulants

•Methylphenidate, Atomoxetine, Modafinil

2.2.10 Antidementives

• Acetylcholinesterase- inhibitors (i.e. Rivastigmine, Donepezil)
• NMDA- antagonists (Memantine)

2.2.11 Substances with abuse and addiction potential

• Substances with activating effects on the mesolimbic dopamine system
-Psychostimulants Amphetamine and its derivatives, cocaine;
-Opioids

-Nicotine
-clinically used psychostimulants: Methylphenidate, Atomoxetine, Modafinil

• Psychotomimetics: 5HT2a-receptor-stimulating substances
- direct-working substances: Indoleamine (i.e. LSD), Phenylethylamines (i.e. Mescaline)
- indirect-working substances (i.e. Ecstasy)

• Psychotomimetics: NMDA receptor blocking substances
- Phencyclidine, Ketamine
- Ethanol

• Substances with exponentiating effects on GABAa receptor- transmitted GABA effects
- Benzodiazepines, barbiturates
- Ethanol

• Adenosine receptor-blocking substances
- Methylxanthine (Caffeine, Theophylline, Theobromine)

• Substances with Cannabinoid receptor- stimulating effects
- Cannabinoid receptors (CB1,CB2) and their endogenous ligands
- Tetrahydrocannabinol (Marihuana, Hashish)

2.3 Pharmacology of histamine

• Occurrence, synthesis, storage, release and inactivation of histamine

• Histamine receptors
- Subtypes and signaling pathways
- Transmitted effects

• Pharmaceuticals with effects on histamine release
-b2- adrenoceptor- agonists (i.e. Adrenaline, Fenoterol)
- Mast cell degranulation inhibitors (Cromoglycate, Nedocromil)

• Histamine receptor antagonists
- H1- receptor- antagonists (i.e. Diphenhydramine, Meclizine, Cetirizine, Loratadine)
- H2- receptor- antagonist (i.e. Cimetidine, Ranitidine)

2.4 Pharmacology of serotonin/5-hydroxytryptamine (5-HT)

• Occurrence, synthesis, storage, release and inactivation of 5-HT

• 5-HT- receptors
- Subtypes and signaling pathways
- Transmitted effects

• Pharmaceuticals with effects on the inactivation and the release of 5-HT
- Inhibitors of 5-HT reuptake (SSRI)
- Inhibitors of MAO-A (Moclobemid)
- 5-HT releasing substances (i.e. Amphetamine, Ecstasy)

• 5-HT receptor agonists
- Buspirone, Urapidil (5-HT1a)
- Triptane (5-HT1b/d)
- LSD (5-HT2a)
- Metoclopramid (5-HT4)
- Ergotamine, dihydroergotamine (partial agonists for various 5-HT receptors)

• 5-HT receptor antagonists
- Methysergid (5-HT2 and 5-HT1d)
- Ketanserin, Risperidone (5-HT2a)
- Ondansetron etc. (5-HT3)

2.5 Pharmacology of analgesics

2.5.1 Opioid-Analgesics

• Endogenous Opioids
• Opioid-receptors und their subtypes

- Signaling pathways

- Transmitted effects
• low potent- and highly-potent Opioid-Analgesics
• partial Opioid receptor agonists and mixed agonists-antagonists
• Opioid receptor antagonists
• Antitussives

2.5.2 Antipyretic Analgesics

• Non-selective COX-Inhibitors
- acidic antipyretic analgesics (non-steroidal anti-inflammatory drugs)
- non-acidic antipyretic analgesics (Paracetamol, Metamizole)

• Selective COX-2-inhibitors (i.e. Etoricoxib, Celecoxib)

2.5.3 Other Analgesics

• Flupirtine and Nefopam
• NMDA receptor antagonists (Ketamine, Dextromethorphan, Dextromethadone)
• a2-adrenoceptor agonists (i.e. Clonidine)

2.5.4 Adjuvant analgesic treatment

• Antidepressants (i.e. Amitriptyline, Venlafaxine)
• Antiepileptics (i.e. Carbamazepine, Phenytoin, Gabapentin)
• Glucocorticoids (i.e. Prednisolone, Dexamethasone)
• Bisphosphonates (i.e. Alendronate, Risedronate)

2.6 Pharmacology of the uric acid metabolism

• Substance for acute gout treatment
- Colchicine
- non-steroidal antiphlogistics and Glucocorticoids
• Pharmaceuticals with effects on the plasmatic uric acid level
- Uricostatics (Allopurinol)
- Rasburicase
- Uricosurics (Benzbromarone, Probenecid)

2.7 Pharmacology of Ion channels

2.7.1 Local anesthetics

• Local anesthetics of the ester-type (i.e. Procaine, Tetracaine)
• Local anesthetics of the acid amide type (i.e. Lidocaine, Bupivacaine)

2.7.2 Antiarrhythmics

• Class 1 antiarrhythmics (Na+-channel blockers: i.e. Ajmaline, Flecainid, Propafenon, Chinidine, Lidocaine)
• Class 2 antiarrhythmics (b- adrenoceptor antagonists: i. Propranolol, Metoprolol)
• Class 3 antiarrhythmics (K+-channel blockers: i.e. Amiodarone, Dronedarone, Sotalol)
• Class 4 antiarrhythmics (Ca++-channel blockers: i.e. Verapamil)
• other substances (Adenosine, cardiac glycosides)
• If-channel blockers (Ivabradin)

2.7.3 Pharmacology of K+-channels

• K+-channel types and their physiologic significance
• K+-channel opener (i.e. Nicorandil, Diazoxide, Minoxidil)
• K+-channel blockers
    -class III antiarrhythmics

-Sulfonylureas and Meglitinides
• Ivabradin

2.7.4 Pharmacology of Ca++-channels

• Ca++-channel types and their physiological significance
• Ca++-channel blockers
- L-type calcium channel blockers (Dihydropyridines, Phenylalkylamines, Benzothiazepines)
- T- channel blockers (Ethosuximides)

2.8 Pharmacology of positive-inotropic drugs

2.8.1 Inhibitors of Na+, K+-ATPase (Digitalis-Glycosides)
•Digoxin, Digitoxin

2.8.2 Sympathomimetics
•Dopamine, Dobutamine

2.8.3 Inhibitors of type III-Phosphodiesterase
•Milrinone, Enoximone

2.9 Pharmacology of vasodilating drugs

2.9.1 Nitro vasodilators
• Glyceroltrinitrat, Isosorbiddinitrat, Isosorbide-5-Mononitrate
•Molsidomin

2.9.2 Inhibitors of type V-Phosphodiesterase
• Sildenafil, Vardenafil

2.9.3 Inhibitors of Angiotensin II-synthesis and-effect
• Renin antagonists (Aliskiren)
• ACE- inhibitors (i.e. Ramipril, Captopril, Enalapril)
• AT1-receptor antagonists (sartans)

2.9.4 Vasodilators with effects on ion channels
• Ca++-channel blocker (L-type calcium channel blocker)
• K+-channel opener (i.e. Minoxidil, Diazoxide)

2.9.5 Hydralazine and Dihydralazine

2.10 Pharmacology of substances influencing the respiratory system

2.10.1 Bronchodilators
• b2 adrenoceptor- agonists

- Substances for inhalation (i.e. Terbutaline, Feneterol, Salmeterol)
- Substances for systemic use (i.e. Clenbuterol, Reproterol)

• Muscarinic receptor antagonists
- Substances for inhalation (Ipratropium, Tiotropium)
• Theophylline

2.10.2 Substances with an anti-inflammatory effect

• Inhalation Glucocorticoids (i.e. Budesonide, Fluticasone, Beclomethasone-DP)
• Inhibitors of mediator-release (Cromoglycate, Nedocromil)
• CysLT1 receptor antagonists (Montelukast)

2.11.1 Benzothiadiazines

- Thiazides (i.e. Hydrochlorothiazide, Bendroflumethiazide)
- Thiazide-Analogs i.e. Chlortalidone, Xipamid, Indapamid)

2.11.2 Loop diuretics

- Loop diuretics type Furosemide (i.e. Furosemide, Torasemide)

2.11.3 Potassium sparing diuretics

- Aldosterone antagonists (Spironolactone, Eplerenone)
- Epithelial sodium channel blcokers (Triamterene, Amiloride)

2.11.4 Carbonic anhydrase inhibitors (i.e. Acetazolamide, Dorzolamide)

2.11.5 Osmotic diuretics (i.e. Mannitol, Sorbitol)

2.12 Pharmacology of blood and the blood producing system

2.12.1 Plasma substitutes

• Colloids Plasma substitute (Dextran, Hydroxyethyl starch, Gelofusine)

• Homologous plasma

2.12.2 Substances affecting blood production

• Iron complexes (i.e. Ferric carboxymaltose)
• Vitamins (Vitamin B12, Folic acid)
• Hematopoietic growth factors
-Erythropoietin (i.e. Epoetin alfa)
- Granulocyte colony-stimulating factor (G-CSF: Filgrastim, Lenograstim)
- Granulocyte-monocyte colony-stimulating factor (GM-CSF: Molgramostim)

2.13 Pharmacology of blood coagulation

2.13.1 Inhibitors of thrombocyte aggregation

• Acetylsalicylic acid
• ADP-antagonists
- Thienopyridine-derivatives (Prasugrel, Clopidogrel, Ticlopidine, Ticagrelor)
- Ticagrelor
• Glycoprotein (GP) IIb/IIIa-receptor-antagonists
- Monoclonal antibodies against GPIIb/IIIa-receptor (Abciximab)
- synthetic GPIIb/IIIa-receptor-antagonists
    Peptidic substances (Eptifibatid)
    Non-peptidic substances (i.e. Tirofiban)

2.13.2 Anticoagulation

• Direct anticoagulation effect
- Heparin (unfractionated Heparin; low molecular weight heparin)
- Heparinoids (i.e. Danaparoid)
- sulfate pentasaccharide (Fondaparinux)
- Thrombin inhibitors (Hirudin, Lepirudin, Desirudin)
- oral factor II- and factor Xa-inhibitors (Dabigatran, Rivaroxaban, Apixaban)

• Indirect anticoagulation effect
- Coumarin derivatives (Phenprocoumon, Warfarin)
- Factor Xa and IIa-Inhibitors (i.e. Apixaban, Rivaroxaban, Dabigatran)

2.13.3 Fibrinolytics (Thrombolytics)

• Direct fibrinolytics (Urokinase, Alteplase etc.)
• Indirect fibrinolytics (Streptokinase, Anistreplase)

2.13.4 Antifibrinolytics

• Aprotinin, ω-Amino carbonic acid (i.e. ε-Aminocaproic acid, Tranexamic)

2.14 Pharmacology of the gastrointestinal tract

2.14.1 Substances with prokinetic effect on stomach and intestine

• Dopamine D2 receptor-antagonists (i.e. Metoclopramide, Domperidone, Alizapride)
• 5-HT4-receptor agonists (i.e. Cisapride, Metoclopramide)
• Motilin-receptor agonists (i.e. Erythromycin)

2.14.2 Ulcer treatment

• Inhibitors of the H+,K+-ATPase (proton pump inhibitors: i.e. Omeprazole, Pantoprazole)
• Histamine H2-receptor antagonists (i.e. Ranitidine)
• Misoprostol
• Antacids (Magnesium- and Aluminum- complexes), Sucralfate
• M1-receptor antagonists (Pirenzepin)

2.14.3 Anti-inflammatory treatment for chronic-inflammatory intestinal diseases

• Sulfasalazine
• 5-Aminosalicylacid

2.14.4 Laxatives

• Lubricants (i.e. Glycerin)
• Bulk-forming laxatives (i.e. Agar-Agar, Methylcellulose)
• Saline und hyperosmotic agents (i.e. sodium phosphate, lactulose)
• Stimulant agents (i.e. Anthraquinone, Bisacodyl)

2.14.5 Antidiarrheal Substances
• Carbo medicinalis
• Loperamide, Diphenoxylate

2.14.6 Antiemetics

• Dopamine receptor antagonists (i.e. Metoclopramide, Domperidone)
• H1-receptor antagonists (i.e. Meclizine)
• Muscarinic receptor antagonists (Scopolamine)
• 5-HT3-receptor antagonists (i.e. Ondansetron)

2.15 Pharmacology of lipometabolism

2.15.1 Inhibitors of Hydroxymethylglutaryl-CoA-Reductase

• Statins

2.15.2 Fibrates

• Clofibrate and Clofibrate derivatives (i.e. Etofibrate)
• Clofibrate-analogs (i.e. Gemfibrozil)

2.15.3 Nicotinacid

• Nicotinic acid
• Nicotinic acid-Analogs

2.15.4 Bile acid sequestrant
• Cholestyramine and Colestipol

2.15.5 Cholesterol absorption inhibitor

• β-Sitosterol
• Ezetimibe

2.16 Pharmacology of diabetic metabolism malfunctions

2.16.1 Insulin

• Human insulin (Normalinsulin)
• Intermediate-acting (i.e. NPH-Insulin)
• Human insulin analogues (i.e. Insulin lispro, Insulin glargin)

2.16.2 Oral Anti-diabetics

• Substances that enhance Insulin-release
- Sulfonylureas (i.e. Glibenclamid, Glimepiride)
- Meglitinide (i.e. Repaglinid)
• Substances that enhance receptor sensitivity
- Metformin
- Thiazolidindiones (Glitazone)
• Inhibitors of glucose absorption (α-glucosidase inhibitors: i.e. Acarbose)
• Incretin (i.e. Exenatide, Sitagliptin)
• SGLT2-inhibitors (Dapagliflozin)

2.17 Pharmacology of hormonal systems

2.17.1 Thyroid pharmacology

• Thyroid hormones (Levothyroxine, Liothyronine)
• Iodine
• Thyreostatics
- Thiourea-Derivatives
- Perchlorate
- Radioiodine

2.17.2 Adrenal cortex pharmacology

• Glucocorticoids (Cortisol und synthetic Glucocorticoids)
• Mineralocorticoids (Aldosterone, Fludrocortisone)

2.17.3 Gonadal pharmacology

• Androgens (Testosterone, Testosterone undecanoate)
• Anti-androgens substances
- Steroids (Cyproteronacetat)
- Non-Steroids (Bicalutamide, Enzalutamide)
- 5α-Reductase-inhibitors (Finasterid, Dutasteride)
- Cyp17A1-inhibitor (Abiraterone)
• Estrogens (17β-Estradiol and its Derivatives: i.e. Ethinyl Estradiol)
• Anti-estrogenic substances
- Clomiphene
- Selective Estrogen receptor modulators (SERM: Tamoxifen, Raloxifene)
- Aromatase-inhibitors (non-steroidal and steroidal substances)
• Gestagens
- Progesterone and Progesterone-derivatives (i.e. Medroxyprogesterone)
- Nortestosterone-derivatives (i.e. Levonorgestrel, Gestodene)
• Hormonal contraception
- Estrogen-Gestagen-Combinations – Mini pill, pure Gestagen drugs
- Postcoital Contraception

2.18 Pharmacology of bone metabolism

2.18.1 Calcium

2.18.2 Vitamin D and its derivatives

2.18.3 Substances with inhibitory effect on bone resorption

• Bisphosphonate (i.e. Alendronate, Risedronate, Zoledronate)
• Estrogen und Raloxifen

2.18.4 Substances with stimulating effect on bone resorption

• Teriparatid

2.19 Antibacterial pharmacology

2.19.1 Inhibitors of *cell wall synthesis*

• β-Lactam-Antibiotics + β-Lactamase-Inhibitors
• Glycopeptides

2.19.2 Proteinsynthesis inhibitors

• Aminoglycosides
• Tetracyclines
• Macrolids and Ketolids

• Lincosamids

2.19.3 Chemotherapy affecting nucleoid acids
• Fluorchinolones (Gyrase-inhibitor: 4 classifications according to the Paul-Ehrlich Gesellschaft)
• Nitroimidazole (i.e. Metronidazole)

2.19.4 Folicacid antagonists

2.19.5 Anti-tuberculotics

2.20 Antimycotic pharmacology

2.20.1 Antimycotics affecting structure and stability of cytoplasma membranes

• Polyenes
• Imidazoles and Triazoles
• Allylamines

2.20.2 Hemmstoffe der Zellwand-Biosynthese

• Echinocandines

2.20.3 Inhibitoren der Nucleinsäuresynthese

• Flucytosin

2.21 Antiviral pharmacology

2.21.1 Virustatics for Herpes treatment (i.e. Aciclovir, Famciclovir)

2.21.2 Virustatics for CMV treatment (i.e. Ganciclovir, Cidofovir)

2.21.3 Virustatics for HIV treatment

• Reverse transcriptase inhibitors
    - Nukleoside-analogues (NRTI)
    - Nukleotide-analogues (NTRTI)
    - Non-nucleoside reverse transcriptase-inhibitors (NNRTI)
    - Integrase-inhibitors
    - Protease-inhibitors
    - Entry-inhibitors
        - Co-receptor antagonists
        - Fusions-inhibitors
    - Current HIV treatment plans

2.21.4 Antiviral treatment for Influenza

• Amantadine
• Neuraminidase-inhibitors

2.21.5 Antivirals for treatment of Hepatitis B and C

• Nucleoside-analogues
• Ribavirin + Interferon Protease-inhibitors

2.22 Pharmacology of substances affecting protozoas and worms

2.22.1 Chemotherapy for protozoan infections

• Malaria remedies
• Substances against toxoplasmosis
• Amoebiasis remedies

2.22.2 Chemotherapy for helminthiasis

• Substances that interrupt neuromuscular activity
• Other Anthelmintics

2.23 Pharmacology of substances affecting malignant tumors

2.23.1 Antimetabolites

• Folic acid analogues (Methotrexate)
• Purine analogues (i.e. 6-Mercaptopurin)
• Pyrimidine analogues (i.e. Fluorouracil)

2.23.2 Alkylating cytostatics

• Nitrogenlost- derivatives (i.e. Cyclophosphamid)
• N-Nitrosourea- derivatives (i.e. Carmustin, Lomustin)
• Platin-Complexes (i.e. Cisplatin)

2.23.3 Topoisomerase inhibitors

• Topoisomerase I inhibitors (Topotecane)
• Topoisomerase II inhibitors (i.e. Etoposid)

2.23.4 Mikrotubuli inhibitors

• Vinca-Alkaloids (i.e. Vincristine)
• Taxanes (i.e.Paclitaxel)

2.23.5 Zytostatic antibiotics

• Actinomycine (Dactinomycine)
• Anthracycline (i.e. Daunorubicine, Doxorubicine)
• Mitoxantron and Amsacrin
• Bleomycine
• Mitomycine

2.23.6 Hormones and Hormone antagonists

• Estrogens
• Gestagens
• Gonadoliberin (GnRH)
• Tamoxifene
• Aromatase inhibitors

2.23.7 New treatment methods

• Monoclonal antibodies (i.e. Rituximab, Trastuzumab)
• Immune system mediators (i.e. Interleukin 2, Interferon)
• Tyrosine-Kinase inhibitors (i.e. Imatinib)

2.24 Pharmacology of Substances affecting the immune system

2.24.1 Fundamentals of humoral and cellular immunity

2.24.2 Immunosuppressants

• Cytotoxic immunosuppressants
- Cyclophosphamide
- Azathioprine
- Methotrexate
- Mycophenolate
• activation inhibiting immunosuppressants
- Glucocorticoids
- Cyclosporine and Tacrolimus
- Sirolimus
• Immunologic immunosuppressants
- Monoclonal antibodies
- Polyclonal antilymphocyte-Globulins

2.24.3 Immune system mediators and their antagonists

• Immunoglobulin (passive immunization)
• Cytokines (Interleukins, Interferons)
• Antagonists of mediators or their receptor
- TNFα-antagonists (Infliximab, Adalimumab, Etanercept)
- Antagonists of the IL-1-receptor (Anakinra)
- monoclonal antibodies of IL-2-receptors (Basiliximab, Daclizumab)

2.24.4 Anti-rheumatic basic therapeutics
• Methotrexate
• Sulfasalazine
• Hydroxychloroquine
• Leflunomide
• TNFα-antagonists (Infliximab, Adalimumab and Etanercept)

2.25 Particular Toxicology

2.25.1 Toxicology of chemical carcinogens

• Chemical carcinogenicity
- Multiple step concept of carcinogenicity
- genetoxic carcinogenics, mechanism of action
- non-genetoxic carcinogenics, mechanism of action

• Carcinogenic substances
- polycyclic aromatic carbohydrates
- aromatic amines and heterocyclic amines
- Nitro-complexes
- halogenated Carbohydrates
- other genetoxic complexes
- Metals
- Particles and fibers
- other non-genetoxic carcinogenics

2.25.2 Inhalation toxins and Methemoglobin builders

• Inhalation toxins with systemic effects
- Carbon-monoxide
- Carbon-dioxide
- Hydrogen cyanide, Antidote (=Methemoglobin builders) and their toxicology
- Hydrogen sulfide

• Irritant gases
- Development of toxic Lung edemas
- Ozone
- Sulfur dioxide

- Nitrous gases
- Chlorine

2.25.3 Toxicology of organic solvents

• Alcohols
- Ethanol
- Methanol
- Glycols

• Aliphatic compounds
- Halocarbon Aliphates (i.e. Chloroform, Dichloromethane)
- Alkanes

• Aromatic compounds
- Benzyl
- Toluene

2.25.4 Toxicology of pesticides

• Insecticides
- chlorinated hydrocarbon compounds
- Cholinesterase-inhibitors
- Pyrethroids

• Herbicides and Fungicides
- Bispyridinium-derivatives
- Pentachlorophenol

• Rodenticides
- Anticoagulants
- Thallium sulfates

2.25.5 Toxicology of metal complexes

•Lead compounds
- inorganic lead silicate
- organic lead compounds

• Mercury compounds
- inorganic mercury compounds
- organic mercury compounds

• Other metal complexes

- Arson compounds
- Cadmium complexes
- Thallium complexes

• Chelating agents as antidotes for metal intoxications
- EDTA
- DMPS
- D-Penicillamine
- Deferoxamine
- Prussian blue

2.25.6 Natural substance toxicology
• Bacterial Toxins
- Tetrodotoxin
- Botulinum-Toxins
- Tetanus-Toxins

• Mushroom toxins
- Muscarine
- Psilocybin
- Amanitins
- Phalloidin
- Aflatoxin, Ochratoxin

• Plant toxins
- Alkaloids
- Cardiac glycosides
- Furanocoumarin

• Animal toxins
- Bee- and wasp toxins
- Spider toxins
- Scorpion toxins
- Snake toxins

2.25.7 Other areas of toxicology

• Toxicology of tobacco consumption
- Nicotine-transmitted effects
- tobacco -specific nitrosamines
- other carcinogens in tobacco(smoke)

• Polyhalogenated aromatic carbohydrates
- Polyhalogenated dibenzo-p-dioxin
- Polyhalogenated dibenzofuran
- Polyhalogenated biphenyl

• Xenoestrogens and Phytoestrogens
- Bisphenol A
- Genistein
• Chemical hypersensitivity (MCS-Syndrome)