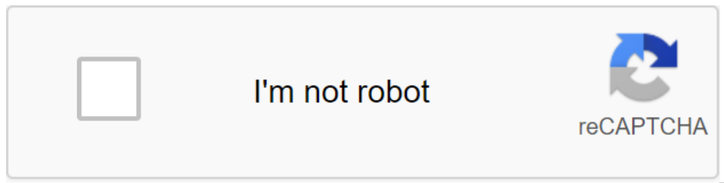

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Pathophysiology lecture notes pdf

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Ким 6 Ревматические заболевания (I) (1 час.) - Д-р Робинсон ревматические заболевания (II), СКВ, Склеродермия (1 час.) - д-р Робинсон (PDF - 1,2 МБ) 7 патогенов ревматоидный артрит (1 час.) - д-р Андерсон ревматических заболеваний (III), Васкулит, Подут (1 час.) - д-р Робинсон (PDF) 8 Биомеханика Обзор сессии (1 час.) 9 Мышечная дистрофия / Воспалительные миопатии (1 час.) - д-р Браун митохондриальной миопатии (1 час.) - д-р Джонс Минеральные Ион Гомеостаз (2 часа.) - д-р Поттс 10 Остеопороз; Остеомаляция (1 час.) - д-р DeMay хряща; Структура Остеоартрит (1 час.) - Д-р Манкин Демонстрация : Joint Dissection (30 min.) - Dr. Mankin Final Examination (2.5 hours.) Arnaud Helmberg These lecture notes accompany my lectures on pathophysiology in the Module study of the Muscoskeletal System at innsbruck Medical University. The English version serves two purposes: as a teaching aid for international students and to encourage German-speaking students to learn medical English; lectures are in German. Translation from the original German version is my own; I'm afraid that sometimes it will sound terrible for native English speakers, but it should at least be understandable. There is also a printed pdf version. Version 1.1 e ©Arno Helmberg 2017 Terms of use 1. HOW OUR MUSULOS WORK Functional block of skeletal muscle is a motor block that consists of a motor neuron and a group of muscle fibers or myocytes. The axon of motor neuron gradually splits and comes into contact with each muscle fiber in one place, neuromuscular denouement or motor end plate. Presynaptic buds release acetylcholine (ACh), which activates the nicotine receptors ACh present at high density on the post-synaptic docking folds of muscle fiber. The activity released by ACh is terminated by acetylcholine esterase. Nicotine receptors ACh acts as an ACh-gated non-selective cation channel, raising the membrane potential to the level required for fire action potential. Myasthenia gravitates. Myasthenia gravis is acquired Disorder. Autoantionia binds to the ACh receptor, causing internalization and receptor degradation. Patients develop marked marked weakness, especially in the evening and on exercise is repeated as in climbing stairs. Antibody levels can be curbed by the administration of glucocorticoids or plasmapheresis, or surgical removal of the thymus, which many patients have contains thymoma. In the event that antibody production cannot be disrupted, symptoms can be mitigated gently by acetylcholine esterase antagonism, such as pyridindigmin. The depolarization of membranes activates the energized channels of L-type Ca2, allowing the extracellular Ca2 channels to reach the cytosol. At the same time, the mechanical connection between the L-type Ca2 channels and the adjacent Ca2 release channels (synonym: ryanodin receptors) in the sarcoplamic lattice membrane releases large amounts of calcium from the cytotula into the cytosol. By interacting with troponin C, Ca2 shifts tropomyosin from myosin mandatory sites to actin, allowing myozin-actin cross-bridge cycling as long as Ca2 remains present: fiber contracts. To stop compression, Ca2 must be removed from the cytoplasm. Most of the Ca2 is pumped back into the sarcoplamic ticculum pump Ca2 type SERCA. Unlike active contraction, muscle lengthening is a passive process performed by the contraction of the opposite muscle group. Cross-bridge bike burns ATP. Tying a fresh ATP unit is required to remove the head of myosin from the actin strands. Atp is then hydrolyzed with the head of myosin, which leads to a conformation of the change in which the myosine throws back the head, allowing you to attach the head to the actin unit two positions further up the chain. While a new cross bridge is formed, both ADP and inorganic phosphate remain attached to the head myosine. The release of phosphate then results in a power blow where myosine bends the head, shifting the relative positions of actin and myosin to cause contraction. The cycle ends with the subsequent release of ADP. Energy sources. As long as Ca2 is present, this process will continue until the ATP is depleted. And even with normal muscle activity, ATP is depleted quite quickly: within a few seconds, which requires several backup lines: the first backup pool is phosphocreatine. Its highly energy-heavy phosphate is transmitted to ADP. This allows you to top up the ATP pool several times, but it still only covers about 10 seconds. The next supply of energy in the muscle cell is glycogen. The total glycogen stored in skeletal muscles is about four times the storage capacity of the liver, about 400 grams of dry weight. Remember that 1 g Glycogen binds 2.7 grams of water, so about 1.5 kg of total body weight depends on the level of muscle glycogen storage. Meta-bilizing glycogenic glucose units generate energy Multiple levels. The breakdown into pyruwat and further lactate generates ATP without the need for oxygen. As long as glycogen is present, this anaerobic metabolism will replenish ATP for almost a minute even in the absence of oxygen, but will soon be limited to acidification and accumulation of lactate. Under normal conditions, oxygen is available even during intense effort, allowing muscles to work on a mixture of anaerobic and aerobic metabolism. Using oxygen, acetyl-coA, generated by the decay of pyrouwat and fatty acids can be burned through a cycle of citric acid and the mitochondrial respiratory chain to give a lot of ATP, but the rate of oxidative metabolism is limited by the rate of oxygen delivery to the muscle. Lipid energy stocks are inexhaustible, allowing muscle activity for many consecutive hours at a reduced rate limited by the oxidative power of ATP production. Hitting the wall during the marathon. Marathon runners work on a mixture of aerobic and anaerobic ATP generation. They maximize their muscle glycogen reserves by carbohydrate load a few days before the event, but despite this, glycogenic reserves of amateur runners are depleted somewhere between km 30 and 35 (miles 19-22). At the moment, the rate of energy production is reduced to the rate of pure metabolism of oxidative fatty acids. Runners, unable to maintain the same pace, experience it as a blow to the wall. Insulin sensitivity. Muscle is the largest storage organ of glycogen, with approximately four times the capacity of the liver. Under insulin stimulation, muscle is the predominant place to remove glucose. In addition, during aerobic exercise, muscles pick up and absorb large amounts of fatty acids, probable causal agents of insulin resistance. One bout of exercise improves the sensitivity of the entire body of insulin for up to 48 hours. Thus, exercise is one of the most effective ways to prevent metabolic syndrome and type II diabetes. Malignant hyperthermia. In genetically predisposed people carrying, for example, alicical variants of the Ca2 release channel, volatile painkillers and succinille can cause cytoplasmic levels of Ca2 to remain elevated during general anesthesia. As we have seen before, in the presence of the cytoplasmic Ca2, the cross-bridge-bike will continue indefinitely, burning huge amounts of ATP and generating huge amounts of heat in the process. This leads to muscle stiffness, acidosis and very high body temperature. The heart rate and breathing rate increases, but is nevertheless unable to compensate for the increase in CO2 production and O2 consumption. The only treatment for this life-threatening condition is dantrolen, a muscle relaxant that prevents the release of calcium by overexcitable Ca2. One potential action in the engine unit produces only a subtle twitch. Much more is required for movements, but Our movements require only a fraction of the strength the respective muscles will be able to generate. How do we produce increments of power? We do this in two mechanisms: repeating the potential of action in the same motor units (summation frequency) by recruiting an increasing number of motor units (multiple fiber summation) However, it is important to understand that not all motor units are created equal. Types of motor units. Individual motor units are homogeneous in fiber type composition. The reason for this is that the neuron engine firing the picture is primarily responsible for choosing the predominant isotype of myosin. The firing pattern is translated as a sample of ca2 cytosolic vibrations. These oscillations, sensitive to Ca2, in turn, cause the expression of one of several isoforms of myosine. Human skeletal muscles contain several types of fibers, express different isoforms of the heavy chain myosine and have different contracting and metabolic properties: Type I fibers are characterized by muscle-heavy chain-1, slow contraction, red hue due to high concentration of myoglobin, high mitochondrial content, relatively low activity of myosine ATPase still high resistance to fatigue. They make up just over half of all fibers that generate ATP mainly by oxidizing fatty acids and are used at any intensity of exercise. About 30-35% are IIa-type fibers, which mainly express heavy chain-2A myosine, have intermediate characteristics, and are recruited at a higher intensity. The remaining 10-20% are IIx-type fibers, which express mainly heavy chain-2X myosine and are characterized by rapid compression. With their high ATPase activity, they are able to generate strong strength and are gained only at high intensity, like 75% VO2max (maximum oxygen absorption). They generate ATP mainly using glycolysis, have low mitochondrial density and pale due to low myoglobin content, leading to low endurance. (The rodents have an even faster type of fiber, IIb.) Smaller motor units tend to be directed by motor neurons with smaller cell bodies. Cnr's limited-intensity stimuli only manage to depolar small motor neurons, allowing for finely controlled, low-power motor movement units exclusively composed of type I fibers. Interindividual differences and plasticity. The distribution of the type of fiber is genetically determined and varies between individuals; However, muscle plasticity allows extensive functional adaptation in response to exercise. It does not seem possible to switch Type I fibers to Type II or vice versa through learning. You can switch between type II fibers with exercise, but the main effect of learning is an increase in the diameter of the fiber. Teh Teh Muscle mass in aging is mainly the result of a reduction in the size of fiber type II, in some quantities also caused by lack of use. Prolonged resistance to the type of training in older people allows to restore part of the lost muscle mass. Metabolism substrate depending on the intensity of exercise and duration. The use of the substrate depends on the intensity of the exercise, which is best measured as a percentage of maximum oxygen absorption (% VO2max). At low intensity, most of the necessary energy is provided by the oxidation of lipids, mainly from free plasma fatty acids. The increase in intensity is mainly fueled by carbohydrates, first by oxidation, but with further increase, an increasing contribution from anaerobic glycolysis. To a large extent, this is the result of a set of fibers. At low intensity, up to 50% VO2max is used only by slow-twitch type I fibers with their high oxidative capacity to lipids. At high intensity, motor units of IIa and IIx fibers are added with increased ATP production, but lower oxygen consumption due to the higher contribution of glycogenosis and glycolysis. Exercise at moderate fixed intensity for a longer time leads to a shift in the contribution of the substrate. During the first half hour, about two-thirds of the energy comes from the oxidation of carbohydrates, but this percentage gradually decreases with the increase in duration. After the glycogenic reserves are depleted after about three hours, the muscles work mainly on lipid oxidation. After stopping exercise, the metabolic rate in our body slowly drops back to normal, but remains slightly elevated for up to 24 hours. In fact, exercise allows us to burn more calories while we sleep! Concentric and eccentric exercises. Depending on the change in muscle length during activity, there are three types of exercise: concentric exercise: a trivial case where the muscles contract during a contract. Isometric exercises: muscle contracts against physical stability of equal strength, making the length of the muscles unchanged (e.g.: the waitress's biceps holding a beer mug at Munich Oktoberfest). Resistance exercise during or near isometric contraction is the most effective way of inducing muscle hypertrophy. Eccentric Exercise: The muscle tries to contract while being passively stretched. It is used to control or cushion traffic, as with a quadriceps step down the stairs. This is only possible if some fibers contract and others relax at the same time, causing large differential forces that can lead to structural disturbances. Delayed onset of muscle and muscle injuries are usually the result of extensive eccentric exercise. With prolonged stress, the muscles acidify, accumulating protons, lactate and extracellular ATP. All of this can be quantified by sensors acting as receptors for afferent neurons. The concentration of proton is felt by ASIC (acid ion sensing sensing receptors, lactate through TRPV1 (transitional receptor potential channel Cation V1) receptors and ATP through P2X (purinergic) receptors. These metabolite receptors are tightly localized on afferent neurons near blood vessels below the muscular fascia, which transmit these measured values as frequencies of potentials for the brain. Increased concentration of these metabolites causes feelings of fatigue (e.g. pH 7.3 and 400 NM ATP and 1 mm lactate), higher concentrations of additional pain sensations (e.g. pH 7.2 and 500 NM ATP and 10 mm lactate). Only a combination of metabolites leads to sensations, experimental administration of single metabolites does not cause any sensations. In fact, muscle fatigue is actually a function of the brain. Blocking the afferent signals will allow the muscles to continue, the process probably ends in serious damage. 3. DELAYED ONSET MUSCLE SORENESS While immediate muscle pain during exercise due to metabolite buildup, muscle soreness the next day is not. While the evidence of delayed onset muscle soreness (DOMS) is rare, it is believed to be due to microtrauma of muscles that is particularly likely to be caused by eccentric exercises. In the part of fibers there is a violation of normal myophilament structures, especially expansion, smearing or even a complete violation of z-lines. In addition, intracellular proteins such as creatine kinase or myoglobin leak into plasma, indicating damage to the cell membrane. Broken membranes also lead to increased levels of cytoplasmic calcium, which can activate calcium-dependent proteolytic enzymes and inhibit normal mitochondrial ATP production. In the second phase of macrophase and neutrophil are injected to remove damaged structures, a process associated with mild inflammation and swelling. Pain is thought to result from the combined action of inflammatory bradykinin, increased extracellular potassium, macrophagation produced by prostaglandin E2 and edematosis pressure. Painfulness can increase with movement as mechanical pressure further stimulates already sensitized type III and type IV (Erlanger/Gasser nomenclature: A and C) nerve endings, especially at the musculin junction. Attempts to treat DOMS are not of much use; Resuming exercise seems to relieve pain most effectively, but this effect is temporary and soreness resumes immediately after discontinuation. With or without treatment, DOMS disappears after a few days. 4. MUSCLE AND TENDON INJURY With increased strength, large structural damage can lead to immediate injury. This affects not only muscle fibers, but also the extracellular matrix, especially collagen fibrillations. Collagen fibrillation are found whole muscles around muscle fibers, but form an increasing percentage of the intersed plane muscle to its origin and insert into the bone. Breaking this this also causes blood vessels to rupture with hemorrhage and immediate sudden pain. Usually caused by eccentric overload, rupture can occur in the muscle or tendon. Surprisingly, it has been shown that the healing process of muscle stresses and injuries greatly benefits from the careful application of specific lengthening (i.e. eccentric) exercises. Pulled hamstrings are typical in dancers and sports involving a lot of sprints like football. Tendons that are difficult to supply with blood due to high tissue voltage are usually ruptured due to pre-existing damage. The most common achilles tendon, quadriceps and patellar ligaments, the bicep's capem tendon and the rotator cuff, especially the suppraspinate muscle tendon, are most common. Achilles tendon rupture usually occurs during actions associated with explosive acceleration in jumping or running. Pharmacology cross-reference: The risk of rupture of the tendon increases in patients treated with fluoroquinolone antibiotics such as ciprofloxacin (hyraz inhibitors). Similarly, the risk increases in patients treated with glucocorticoids, especially if they are injected directly into the tendon to treat inflammatory symptoms. Inflammatory mediators, such as TNFH, induce matrix metal proproteases such as collagenase and glucocorticoids, have an overwhelming effect on transcription of the type I collagen gene. The risk of muscle injury increases in people taking statins. 5. MUSCLE CRAMPS Muscle cramps are sudden involuntary muscle contractions that can be excruciatingly painful. Everyone experiences cramps from time to time, but cramps can occur quite often in certain typical situations. Convulsions can be caused by easily forcibly infecting an already shortened muscle. Some people are prone to night leg cramps, especially with increasing age. Convulsions are common in the third trimester of pregnancy and after prolonged exercise, especially in the presence of an imbalance of volume and electrolyte in hot and humid conditions. As a rule, circumstances that cause a sharp decrease in extracellular volume predispose to convulsions: severe sweating, diarrhea, vomiting, diuretic treatment or hemodialysis. In addition, convulsions can be caused by neurological disorders affecting lower motor neurons or disorders such as cirrhosis of the liver or hypothyroidism. The pathophysiology of convulsions remains completely unclear. There is a broad consensus that the increase in excitability is not in the muscle cells itself, but in motor neurons, causing electromiographic discharge rates to 150 Hz, but the consensus ends right there. Central hypothesis finds trigger bodies of cells in the abdominal horn of the horn cord, while the peripheral hypothesis sees the origin somewhere along the peripheral nerve, most likely near the neuromuscular compound. What can be done against seizures? Typically, stretching the affected muscle provides immediate relief. Stretching the calf before bedtime can reduce the frequency of night leg cramps. Preventing dehydration and hyponatremia in sports is important, and magnesium replacement has been shown to have some effect in pregnancy cramps. Pharmacology cross-references: Some drugs are highly effective, but carry risks of side effects

that may be too onerous for benign conditions like cramps. The sulfate is a classic drug for reducing the frequency of seizures, but can cause hearing and vision problems. Anticonvulsants reduce the excitability of motor neurons, but come with severe side effects. In addition, creatine and calcium channel blocker verapamil have shown some effectiveness. 6. TRAINING ADAPTATION Acute bouts of exercise cause changes in metabolite concentrations, which are recorded by molecular sensors and return to gene expression regulation. Of the many types of sensors recognized, let's look at three as an example: oxygen deficit sensing: acute exercise uses a large amount of oxygen, thereby reducing the partial oxygen pressure in muscle fibers. This stabilizes HIF-1 (hypoxia-induced factor 1), a transcription factor that enhances expression, such as glycolytic pathway enzymes. Most likely, this mechanism is responsible for the beneficial effects of high-altitude training. Feeling energy deficit: exercise burns ATP; increased levels of AMP alesterically activate AMP-activated protein kinase (AMPK), which inhibits glycogen synthesis and protein synthesis, but promotes glucose transportation and lipid oxidation. Chronic activation of AMRK causes mitochondrial biosynthesis. Reset Sensing: A high-strength resistance exercise activates phospholipase D through a path that is not yet clear enough. Phospholipase D releases phosphate acid from sarcolem. Phosphate acid activates mTOR (the mammal target of rapamycin). Through several pathways, mTOR increases ribosomes and mRNA translation, leading to increased muscle protein synthesis. Combined with adequate dietary protein intake, this mechanism induces the phenotype of hypertrophy desired by devotees of six packing abs and bulging biceps. The first two mechanisms indicate that for optimal training we need bouts of high-intensity exercise: the lowest levels of intracellular oxygen and the highest levels of AMP are achieved at the highest intensity of muscle activity. Of course, high intensity can only be maintained during the Terms. If we want to maximize this effect, we can only add additional bouts of intense exercise separated by recovery intervals. Especially since we come to a high-intensity interval interval (HIIT), which is a necessary component of optimal training even for endurance sports. Thus, each training strains the musculoskeletal system and can cause little damage here and there, but it is followed by acute regenerative changes in gene expression: mRNA levels in many genes go up. This mRNA reaction is short-lived, but results in the synthesis of additional units of muscle proteins and enzymes. Proteins have a longer half-seed period than mRNA, and begin to accumulate. In other words: immediately after acute exercise, the functionality of the muscles is reduced, but this phase is followed by a wave of regenerative recompensation. With the proper training period of units, levels of functionally important proteins, such as myosine, actin, enzymes, mitochondrial proteins, can be hatched to higher levels. Over time, this process leads to an increase in muscle metabolism and exercise performance. From this, it is clear that dosage and timing of exercise is crucial. If bouts of exercise are too intense and/or time too close, there is not enough room for regenerative recompensation and the muscles gradually weaken: we have overtrained or rather detraining. If unit exercise time is too rare, the window of regenerative over-compensation has passed and the system returns to where it was before: we never reach higher levels. The trick is to place the next fight exercise right on top of the over-compensation phase. We need bouts of exercise to trigger an answer, but we actually improve during the later stages of rest. Physical training is a systematic exercise in the continuum between the two extremes of aerobic (endurance) and resistance (strength). Two forms of exercise cause different adaptations: Resistance exercise causes muscle hypertrophy, with increased fiber size through the synthesis of myofibrillar protein. The affected muscles grow in volume and power. These adaptations occur most prominently in type II fibers, with an accompanying increase in anaerobic ability. Aerobic exercise increases endurance by increasing the synthesis of mitochondrial protein and oxidative function, mitochondrial density, capillary and lactate tolerance. After six weeks of aerobic training, the density of the mitochondrial muscle increases by 50-100%. Systemic effects include a marked increase in heart stroke with an associated decrease in heart rate rest and an improvement in cardiovascular risk. One of the regulators of gene expression most clearly associated with mitochondrial biogenesis is PGC-1 (peroxysome spreader-activated gamma-coactivator receptor 1). PGC-1 is a transcription co-agent, many genes in energy metabolism. PGC-1' reexpression increases mitochondrial biogenesis, respiratory capacity, ATP synthesis and improves exercise performance. In addition, PGC-1 PGC-1 required for angiogenesis caused by exercise. Polymorphisms in genes that encode proteins important for muscle activity affect athletic performance. Let's look at just one of the many examples: SNP's -actinin-3, protein helps cross-line actin filaths in Type II fibres. The two alleles are distributed across the human population at roughly comparable frequency: R allele contains arginine at 577, while X allele contains a nonsense mutation R577X, a stop-codon leading to a protein fragment that is quickly broken down. In Europe, about 18% of the population of XX is homozigotic, completely lacking in actinin-3. No disease of phenotype is associated with this deficiency; A very similar protein to No-actinin-2 works as a backup. Elite sprint and power athletes have significantly higher frequencies of 577R allele than controls, while endurance athletes tend to have higher X allele frequencies. Recall that endurance exercises rely mainly on type I fibers, where the actinin-3 plays no role. As another example, androgens have a positive effect on muscle buildup and other relevance parameters in sports competitions. A number of genes affect the concentration of testosterone, which is also present and active in women (in the absence of doping), albeit at much lower concentrations than in men. It has been shown that athletes with higher concentrations of free testosterone have a significant competitive advantage, for example, in running 400 and 800 m or in a hammer throw. The competitive advantage in the 400m and 800m was about 2%, when the highest thorn was compared to the lowest. The competitive advantage even amounted to 4.5% in the hammer throw. In today's sport, talent scouting means phenotype screening to identify children with favorable combinations of sports alleles (talent). Genetic testing is expected to complement this process in the near future. Sports best results are achieved only if the optimal training regimes coincide with the most favorable genetic background. 8. GENETIC DISEASES Many genetic diseases affect the function of skeletal muscles. Examples: Muscle dystrophy is characterized by creeping death of muscle cells due to the deficiencies of one of many different proteins, leading to progressive muscle weakness. One of these proteins is dystrophin, affected in the types of muscular dystrophy duchenne and Becker. Distrophin is a component of a large cross-membrane protein complex, tying intracellular myophilaments to extracellular matrix fibers. Distrophin acts as a shock-absorbing spring. In its absence, the compression force leads to repeated damage to the cell membrane, causing eventually cell death and replacement of fat cells. Dystrophin gene our largest genome, representing 0.08% of the human genome located on the X chromosome. X chromosome. Takes 16 hours to produce a huge primary transcript and splice it into a mRNA consisting of 79 exons. Sporadic mutations occur frequently, accounting for a third of cases. X-related inheritance means that the disease primarily affects boys. Depending on the individual mutation, the amount of remaining dystrophin determines the severity of the disease. In Becker's muscular dystrophy, truncated dystrophin remains partially functional, allowing you to survive in old age. Glycogen storage diseases: In light of the importance of glycogen to cover the energy needs of muscles, defects in glycogen synthesis or metabolism necessarily negatively affect muscle function. Mitochondrial diseases: For mitochondria, the most effective ATP generator, the same argument is valid. Subclass of mitochondrial diseases, affecting neuromuscular functioning, is called mitochondrial myopathy. Defects can be in mitochondrial DNA or in nuclear genes encoding macromolecules imported into mitochondria. 9. TOXINS Botulinum toxin is a neurotoxin protein produced by Clostridium botulinum. Heat-labile toxin sometimes causes food poisoning when spores anaerobicly growing bacteria contaminated canned food. It is one of the most potent toxins known with a lethal dose (LD50) of 1-2ng/kg when administered or ten times that when inhaled. The toxin enters the axon terminals and proteolytally degrades one of three proteins called SNAP-25, VAMP/Synaptobrevin or syntaxin, all of which are needed to merge bubbles with the presynaptic membrane of the motor end plate. The release of acetylcholine is reduced, causing sluggish paralysis. Death can be the result of respiratory failure. Pharmacological cross-references: Diluted botulinum toxin has been used to treat squint, with injection into individual extraocular muscles every six months. In addition, it is used under several conditions under which it is desirable to relax specific muscles, as in various forms of dystonia. Cosmetically, it is used to prevent or reduce wrinkles by paralyzing facial muscles, with the inevitable side effect of lowering facials. Tetanus toxin is another protein-neurotoxin produced by Clostridium tetani. Anaerobic growing bacterium is feared of wound infections. As with botulinum toxin, tetanus toxin enters the axon terminals, but in this case suffer mainly inhibitory interneurons, releasing glycine or amino acid (GABA) in the spinal cord. The breakdown of VAMP/Synaptobrevin in these Renshaw cells, which have a relaxing effect in a precisely tuned closed loop system that regulates muscle tone, causes a prolonged spasm at the slightest stimulus for the motor neuron. Clinical tetanus begins short nerves, which leads to characteristic symptoms of sardonic rice and lojav. Death can be caused by breathing problems due to Paralysis. As with botulism, binding the toxin is irreversible, requiring intensive care for weeks or months until new axon endings have grown. Tetanus is easily prevented by vaccinating an inactivated form of toxin, toxoid tetanus, which causes the neutralization of antibodies. Curare is a common name for plant extract poisons used by indigenous South American people for arrows or darts. Alkaloids are competitive and reversible suppress the nicotine receptor ACh, causing sluggish paralysis. *** *** pathophysiology lecture notes pdf. pathophysiology lecture notes ppt. advanced pathophysiology lecture notes. nursing pathophysiology lecture notes