Renin-angiotensin system is composed of a multistep cascade of on each other dependent substances. The key substance and a limiting factor is the enzyme rennin. This enzyme is produced in the juxtaglomerular apparatus of the kidneys. Renninangiotensin system exists in other tissues too. This extrarenal system is subjected to an intensive study mainly in the vessels.

Angiotensin II binds to the cellular membrane receptors and stimulate Ca^{2+} influx, but do not activate adenylcyclase. Angiotensin as well stimulates the biosynthesis and proliferation of smooth muscle. It causes a constriction of the systemic arterioles (by its direct effect on the pre capillary resistant vessels). During the physiological conditions there is a dynamic equilibrium between the pressor and the depressor mechanism, this equilibrium keeps the blood pressure in the optimal range. (Arterial hypertension can be the consequence of a disorder of the mentioned equilibrium being either due to the relative or the absolute excess of the pressing factors or the absolute excess of the pressing factors or the inadequacy of the depressing factors).

Differing from the nervous regulatory mechanisms, that can react within few seconds, other **regulatory mechanisms need longer time for exerting their effect**.

1) Transcapillary shift of fluids (the flow of fluid out of the capillaries or into the capillaries): With blood pressure change there will be a change in the capillary pressure. When the arterial blood pressure drops down there will be a consequent drop of the fluid filtration through the capillary membrane into the interstitial space and hence increasing the amount of the circulating blood. Contraversly, in cases of the increased blood pressure there will be fluid escape into the interstitial space. This mechanism reacts slowly.

2) Mechanism of vascular adaptation: For example after a massive blood transfusion there will be an initial raise in the blood pressure, yet after sometime – 10 min. till one hour – and due to a vascular relaxation the blood pressure returns to the normal even though the blood volume increase by nearly 30 % over the normal level. Contraversly post a massive bleeding this mechanism can lead to a vasoconstriction enclosing the remaining blood volume and by this keeping the normal haemodynamic. This mechanism has its restriction by which it can cor-

rect only changes ranging between +30 % till -15 % of the blood volume.

Long lasting regulation of the blood pressure is obtained mainly by the **kidneys as an organ**. Aldosteron limits water and salt loss.

The renal mechanisms of sodium and water excretion have the greatest importance for the **long lasting regulation**. With the raising blood pressure there is a consequent raise of the perfusion pressure in the kidneys and sodium and water excretion in the urine. A raise in the blood pressure that results from a raise in the cardiac output (for e.g.: in cases of expansion of the body fluids) when normal renal function will evoke **pressure diuresis and natriumuresis** and hence decreasing the volume and the blood pressure. In renal function disturbance e.g. in low blood flow through the kidneys which result from the general drop of the blood pressure, or from a loss of functional kidney parenchyma there will be sodium and water retention in the organism that will consequently lead to raise in the venous return, cardiac output, and blood pressure.

There will be an establishment of a new state of equilibrium that characterizes most of the hypertension cases. A high blood pressure, a high peripheral resistance, normal cardiac output, and a normal volume of body fluids. This condition modifies the function of baroreceptors, sympatico adrenergic mechanisms, rennin-angiotensin system, mineralocorticoids and other factors.

3.14 Systemic arterial hypertension

Systemic arterial hypertension is a long-lasting, usually permanent elevated blood pressure (BP) in the systemic circulation. It might usually concern only of the systolic BP, and respectively only of the diastolic blood pressure, or it might concern both of them at the same time.

Increase of BP can be determined:

a) by the increase of the cardiac output or by the

increase of total circulatory blood volume – volume hypertension;

b) by the increase of the total peripheral vascular resistance – resistance hypertension;

c) by the decrease of the vascular compliance or elasticity – so called a compliance hypertension.

Some physical factors of the blood like high viscosity, etc. might play a supporting role in the development of arterial hypertension. The blood pressure within a population in the physiological conditions has wide inter individual, and even intraindividual differences. Inter individual variability of the BP is affected by the age, (in children the blood pressure is low and it raises with age), sex, body constitution, body weight, and by other factors. The blood pressure is changing during the day in every normal individual. It is usually lowest in the early morning hours, and it is at its highest level in the afternoon and in the evening. Based on epidemiological data of the world health organization (WHO) three bordering values of BP for the adult individual were estanlished. The value of 160/95 mm Hg (21,3/12,7 kPa) is regarded as a border of the abnormally high blood pressure.

The normal blood pressure of adults is defined by the upper border of the systolic BP 140 mm Hg (18,7 kPa) and a diastolic blood pressure of 90 mm Hg (12,0 kPa). The BP between the values of which are considered as normal and the value 160/95 mm Hg, there is a line of values that are known as the suspicious values (boderline values).

The professionals in the commitee of the WHO have accepted the classification of the systemic arterial hypertension according to **the value of BP** and **the extent of the organ injury** into three stages:

I. A raised blood pressure without any objectively present signs of organ injury.

II. The presence of at least one of these signs of organ injury:

- a left ventricular hypertrophy (proven by radiography, electrocardiography, or echocardiography);
- a generalized or focal arterial narrowing of the retina vessels;

- a disturbed renal function – proteinuria, possibly a slightly raised creatinin in the plasma (this stage can be characterized as the stage of a cardiovascular hypertrophyas well).

III. Organ injury is manifested by same subjective and objective signs:

- left ventricular insufficiency;
- hemorrhages into the brain, the cerebellum, or the brainstem, hypertensive encephalopathy;
- hemorrhages and exudates into the retina (the III stage could be characterized as the stage of a cardiovascular injury).

This classification reflects the fact that, the systemic arterial hypertension – no matter what the etiopathogenic mechanism is - is not merely a raise of the blood pressure but it is a disease where the whole cardiovascular system is affected, with the affection of other vital organs, mainly the brain, and the kidneys. These changes may combine, so that many organs can be affected simultaneously and elsewhere the main pathology is in the only one organ affection.

The most dangerous stage (III) may turn into a malignant form of a disease (called malignant or accelerated hypertension). What characterizes this type is the changes in the diastolic blood pressure that may reach 130 mm Hg (17 kPa), some complicated retina changes and a rapidly progressing renal failure, cerebral failure, and heart failure. In the non treated individuals this malignant form ends within 1–2 years by exitus. The malignant progression is caused by these three mechanisms:

1. An abnormal raise of the blood pressure

2. Activation of the rennin angiotensin system

3. Microangiopathic hemolytic anemia.

An abnormal raise of the blood pressure will cause changes of the permeability of the arteriolar endothelium, that leads to a leak of some plasma particles – including fibrinogen – into the vascular wall. We may prove the presence of some tears on the retinal vessels by special techniques. The rennin angiotensin (RA) system is accomplished mainly by its prominent vasoconstrictive effect. The activation of this system by the abnormally high loss of Na^+ and

hence loosing body fluids due to the pressure diuresis will lead to a vicious circle formation.

Although a new balance is established by loosing the excessive amounts of fluid, yet the vasoconstrictive effect of angiotensin and hence the BP is still raising. The microangiopathic hemolytic anemia that develops during the malignant transformation of hypertension can occur due to a mechanical injury of the erythrocytes during the micro circulatory disturbance – erythrocyte haemolysis and due to the release of the coagulatory factors that result from the raised blood pressure in the arterioles. Yet we may deal with a case of a primary coagulation disturbance that is the formation of intramural and intraluminal thrombi in the small renal arteries – as a result of accumulation of the stimulated thrombocytes on the vascular wall and a consequent alteration of the erythrocytes and their haemolysis.

At last, the third criteria recommended by the WHO in the classification of hypertension is according to **the etiology**. Most commonly (90–95 %) the cause of the high systemic blood pressure is unknown and that is why we call this type of hypertension as the essential hypertension (primary or idiopathic). And on the other hand a hypertension that is accompanying a known primary disease is known as the secondary (symptomatic). By this way the secondary hypertension is usually joined to many renal diseases, cardiovascular, endocrine, and nervous system diseases. The highest proportion of diseases that are associated with the secondary hypertension is given to renal diseases.

3.14.1   Essential hypertension

Is the most common form of hypertension. According to some statistics it forms nearly 90–95 % of all hypertension cases. This disease affects about 15 % of the world population.

Etiology and pathogenesis of essential hypertension is only partially understood. Due to a large number of factors and pathogenic mechanisms, that participate in the development and progression of hypertension their pathogenesis is rather complicated. The heterogenesity of the factors which lead to the eventuall effect – increasing the systemic arterial blood pressure – is the cause of the fact that its has not been unified yet. It seems that it is not even possible, because according to the newest information essential hypertension is a common name for the

regulatory disturbances of the BP, which might have various causes of development and therefore different pathogenic mechanism. Most of the theories which try to explain the pathogenesis do agree on that there is an disoirder in the blood pressure regulation (this disturbance may probably affect any parts of the regulating chain), that is due to some internal (endogenous) or external (exogenous) factors.

The endogenic factors are multifactorial, including genetic ones. The exogenous factors are the realizators of the genetic propensity, and they include primarily a high salt intake, high energy provision and some psychogenic factors.

3.14.1.1   Genetic and familiar affects

It is known, that hypertension usually affects more than one member of the family. The blood pressure, similarly as other quantitative constitutional signs, is to a certain limits similar in all members of the same family.

The decisive factor yet is considered to be the inheritance of those factors that have some importance in the etiology and the pathogenesis of the essential hypertension. It was proven that some biochemical and other markers, and even some reactions to different stimuli – that are present in people with essential hypertension – can be noticed also in still healthy normotensive members of hypertensive families:

- There might be some genetically conditioned changes of the metabolism and the release of catecholamines.

- Fast release of (NE) noradrenalin from the thrombocytes, can be one of the genetic markers (the place of NE storage are even the thrombocytes).

- Low contents of kalicrein (a depressor factor) was found in some children of hypertensive families.

- Apart from the discovered high systolic and diastolic blood pressure as well as the body weight in children of the hypertensive families, the have also a significantly low level of plasma aldosteron.

- There is also a genetically based high sensitivity to Na^+ expected in the essential hypertensive people.

- There might be a genetic factor that is expressed even due to stress (e.g. the normotensive people react differently to various psychogenic stimuli by increasing the blood pressure and a long lasting increment of the BP.

- Meanwhile there is an intensive study about some enzyme transport systems, mainly for Na^+, K^+, Ca^{2+} (in the kidneys and the vascular wall, in erythrocytes, leukocytes, and lymphocytes). The genetic determinant of these transport abnormalities in the patients suffering from the essential hypertension was shown.

The question of genetic markers is very important for the practical field – mainly for the future. As markers blood and serum groups are being studied before all. Meanwhile it is the HLA system and other systems that influence the immunity. For hypertension they are important only for its familiar predilection and also for prognosis of atherosclerosis development and its complications. The hereditary factors basically participate in the variability of the blood pressure and in the genesis of the essential hypertension. The type of inheritance is most probably by a polygenic, additive and it further more interacts with exogenic factors.

3.14.1.2   Factors of the external environment

SALT   The relation between the salt and hypertension development has been known since the beginning of this century. Its role in the pathogenesis is based partly on many epidemiological studies (from different regions of the world), from which it was clear that the prevalence of hypertension is directly related to the amount of salt intake. And partly due to some clinical studies, that refer to that lowering the blood pressure is parallel with decreasing the extra cellular fluid that may be accomplished by diet containing markedly low quantities of salt or by continuous diuretic therapy.

Increasing the salt intake will result in increasing the volume of extra cellular fluid. This fact results in a larger venous return to the heart, that will consequently cause an increase the cardiac output and due to autoregulation peripheral vessel resistance will be secondarily increased. According to Guyton the peripheral tissues protect themselves in this way from high perfusion, if they are not functioning. Another

possibility is a primary increase of the peripheral resistance. During an abnormally high natrium intake there will be an increase of natrial concentration in the muscle cells of the vascular wall, that will consequently result in the retention of more Ca^{2+} ions leading to higher vascular wall sensitivity to vasoconstricting agents.

According to the latest studies concerning the pathogenesis of essential hypertension the genetic defect of kidneys to excrete salt plays a very important role. Yet, the exact mechanism that results in increasing of the blood pressure is still not exactly understood or proven. One of the possible explanations that are accepted nowadays are the changes of the cation transport across the cellular membrane. To maintain a constant low Na^+ concentration of Na^+ intracellularly, the Na^+ has to be expelled out across the cellular membrane using these active transport mechanisms:

1. Na^+–K^+ pump: actively expels Na^+ extracellularly against the concentration gradient. The needed energy for this active process is supplied from the hydrolysis of ATP with the aid of the Na^+, K^+ dependent ATPase. The activity of the Na^+–K^+ ATPase is a measure of the natrium pump activity. From the quantitative point of view natrium pump is responsible for about 80 % of the active transport of natrium from the cell, the action of which is inhibited by ouabain or digoxin.

2. Na^+–K^+ cotransport mediates a simultaneous unidirectional transport of Na^+, and K^+ and may be also chlorides intra– or extracellularly.

In physiological conditions these and other transport systems from an optimal electrolyte composition of the intracellular fluid. A disorder of these transport mechanisms can decrease the active transport of natrium from the cell. This means that during an unchanged passive intracellular transport the content of intracellular Na^+ will raise. This raise of the intracellular Na^+ concentration causes a raise of the concentration of free intracellular Ca^{2+} as well (due to the fact that there is close relation between the intracellular Ca^{2+} concentration and a transmembrane Na^+ gradient due to the presence of Ca^{2+}–Na^+ exchange mechanism. Even a slight raise of the intracellular natrium concentration leads to an increment of Ca^{2+} transport intracellularly.)

These transport systems do exist even in the formed blood elements such as erythrocytes, leukocytes, and lymphocytes. This provides us with the chance to study the activity of those transport systems for Na^+ also in human and not only in experimental animals. The activity of Na^+–K^+ ATPase was proven to be low in erythrocytes, leukocytes, and even lymphocytes of patients with essential hypertension.

Low Na^+–K^+ ATPase activity is more prominent in patients with high or normo rennin essential hypertension (according to the plasma rennin activity we classify hypertension as: low-, normo-, and high rennin hypertension). Upon increasing the volume of extracellular fluid and hence increasing the extra cellular Na^+ content the organism will compensate this by increasing the level of natrium uretic substances, mainly, the atrial natriuretic peptide (ANP), which is formed in the cardiac atria and its function is realized in the kidneys ANP increases the excretion of Na^+ by increasing the glomerular filtration and inhibiting its tubular reabsorption. It also lowers the aldosteron production. The other of the natrium uretic substances is a natrium uretic hormone that inhibits Na^+–K^+ ATPase, which will consequently lead to a limited transport into cells or to expulsion of Na^+ outside the cells, and hence to an increase of the intra cellular Na^+ content followed by an increase of intracellular Ca^{2+} content as well (as explained previously). It is not clear yet whether the natrium uretic hormone and digitalis like endogenous substances (digitalis – like compounds) are the same and the only Na^+–K^+ ATPase inhibitor.

As a consequence of all we mentioned is that there might be a congenital primary defect of the transmembranous Na^+ transport caused by a high level of a humoral substance – that is supposed to be natriuretic hormone.

What is more important here is that during the mentioned exchange mechanisms intracellular Ca^{2+} concentration increases, which is then a trigger mechanism for muscular contraction of vessels. By this mechanism the increased Na^+ concentration in the myocytes of the vascular wall could lead to an increased susceptibility for vasoconstriction stimuli and by this to become an important pathogenic mechanism for the development of hypertension.

KALIUM (K^+)   There is a lot of evidence that a high K^+ intake is protective against hypertension and maybe even against other hurtful effects of high natrium intake. High kalium intake results in drop of the blood pressure. (Individuals that consume mainly vegetarian food have a low blood pressure). The combination of low Na^+ intake and higher K^+ intake is more effective than low Na^+ intake alone.

There are many possibilities of the hypotensive effect of kalium:

1. It causes diuresis and hence lowers the plasma volume

2. In patients treated with K^+ there is a drop in the body weight and there is a decrease of Na^+ content in the organism

3. It inhibits the plasma rennin activity

4. It can cause vasodilatation due to a direct effect on the arteriolar smooth muscle.

MAGNESIUM (Mg^{2+})   It was found that adding Mg^{2+} (in the form aspartate hydrochloride) increases the depressor effect of the diuretics. Any disturbance of Mg^{2+} metabolism may result in generalized muscular contraction and hence affecting the blood pressure. Mg^{2+} is Na^+–K^+ ATPase activator and it is Ca^{2+} antagonist. When the level of Mg^{2+} is low it causes an increase of the intracellular Ca^{2+} concentration and hence promotes vasoconstriction.

OBESITY   Practically all the epidemiological studies point to that there is a direct relationship between the level of the blood pressure and the body weight. This relationship concerns the primitive as well as the developed polulations, and also concerns both the children and the adults.

To explain the relationship between the obesity and the blood pressure we noticed that the obese people, that expend more kJ need as well a higher expenditure of salt per day. In obese people there might be hyperinsulinemia and as well as insulin resistance. Insulin enhances the retention of natrium in the kidneys. Too much eating is also accompanied by an increase of the sympathetic tonus and an increased noradrenalin turnover.

PSYCHOEMOTIONAL STRESS   In the interaction with other mechanisms the neurovegetative system also takes part in the regulation of blood pres-

sure. Also its function arises from the basic circulatory functions – in any case to ensure the supply of oxygenated blood under the required blood pressure to all organs and tissues according to their actual needs.

The CNS reacts to exogenous stressory factors (stressors of the outside environment) actually via a dual efferent stereotype which affects also the blood pressure:

1. Activating the sympathetic system that leads to the release of catecholamines from the adrenal medulla and this is characterized by some known reactions.

   (a) fight (associated with vasodilatation in all limbs)

   (b) flight (vasodilatation only in lower limbs)

2. Activating of the adenohypophysis and via the adrenocorticotropic hormone the stimulation of the adrenal cortex.

In the initial phase of stress there will be an activation of antidiuretic hormone (ADH), that is formed in the hypothalamus. After its release from the neurohypophysis (where it is only stored) into the circulation, it acts on the distal and the collecting tubules of the kidneys. Its action lies in enhancing the reabsorption of water. Apart from this it shares in the modulation of blood pressure. In the beginning of the stress situation and as a result of the peripheral vasoconstriction there will be a lowered renal perfusion, that leads to the activation of the rennin – angiotensin I, II, III – aldosteron system.

Aldosteron increases the volume of body fluids by the reabsorption of Na^+ and hence water in the distal tubules. Angiotensin II is a pressor factor. It stimulates vasoconstriction via a direct mechanism. It enhances the synthesis and the release of noradrenalin from the nerve endings and it also blocks its uptake by the nerve terminals. Apart from this it stimulates adrenaline and aldosteron release from the adrenals as well as the vasopressin from the neurohypophysis, what will consequently lead into increasing the vascular susceptibility to vasoconstricting agents.

Along with the stimulation of the sympathetic nervous system and the adrenal medulla, there will be also the release of hormones of the anterior lobe of the pituitary (adenohypophysis), from which the

most important one in the stressory situations is the adrenocorticotropic hormone (ACTH).

The accepted fact meanwhile is that a high blood pressure is associated with certain personality characters as well as with the type of occupation. Apart from this in about 30 % of hypertensive people we are dealing with a hypertension that is only present at work (white coat office hypertension). From this point of view there are some interesting studies, that classify people according to their behavior and reactivity into two types: type A and type B. Type A people – who are predisposed to hypertension are characterized by high agility, ambition, psychological instability that might turn into aggressively and impulsive behaviour, the person is despotic and egocentric. People of type B are characterized as phlegmatic, psychologically stable, with no personal ambitions.

3.14.1.3   Haemodynamic changes in essential hypertension

During the initial stage of the essential hypertension the cardiac output is increased and tachycardia is present. The causes and the mechanism of an increased cardiac output in hypertensive patients with the initial stage of EH are due to an increased sympathetico-adrenal activity. It acts directly on the heart and the vascular structure, where there is an increased tension of the vascular wall in the resistant and the capacitance (venous) field. Narrowing the venous field will increase the preload and could be the primary cause of the increased cardiac output.

But more marked haemodynamic changes can be seen in people with the essential hypertension during the physical activity. During the early stages of the hypertension there will already be a drop in the cardiac output due to the drop of the systolic output. However, the resistance of arteries increases. In the late stages the signs of hypokinetic situation due to the subnormal systole become even more prominent.

In patients with long lasting hypertension the high blood pressure is the result of a high peripheral resistance in case of a low functioning myocardium, or a marked cardiac insufficiency. The first change occurring in the vessels can be a functional vasoconstriction or some structural changes in the vascular wall.

During vasoconstriction that is caused by a high sympathetic tonus, concentration of Na^+, Ca^{2+} and

water content in the vascular wall also increase. Later on there will be some structural changes in the wall of the vessels. A thickening due to the hypertrophy of the media and a hyperplasia of the collagen fibers. That is a cause of the changes in the relation between the thickness of the vascular wall and its lumen. The narrowing of the lumen alone can increase the peripheral resistance. In the patients with a developed hypertension (II. stage) the high peripheral resistance is caused by vasoconstriction and by the structural changes in vascular walls.

The arteriolar vasoconstriction and the vascular resistance do not occur in all the organs equally in the essential hypertension. The most affected are vessels of the skin and kidneys, whereas the skeletal muscles are perfused normally.

3.14.1.4 The consequences of the hypertension for the organism

Hypertension basically has two injurious consequences for the organism:

1. It causes an overload on the left ventricle

2. Causes some degenerative changes in the arteries.

1) The left ventricle must continuously pump blood against an increased resistance, which means that it must perform a compensatory hyperfunction. The left ventricle becomes gradually hypertrophied and its weight might markedly increase. The hypertrophied left ventricle can compensate this process for a long time. It depends on a level of the mean arterial pressure, and on the state of the myocardium. If the blood pressure is no more increasing, still the myocardium becomes gradually worn out. Cardiomyofibrosis might develop and this might result into the left ventricular failure.

2) If the hypertension last for a long time, there will be degenerative changes in the vascular wall (sclerosis, atheromatosis, hyalinosis, and fibrinoid degeneration).

These changes, which are provoked, or the formation of which gets faster by the action of continual high blood pressure on the vascular wall, will themselves be the cause why hypertension becomes fixed because they make the vascular lumen narrower and on the other hand they decrease the elasticity of the vessels. The vascular changes affect some regions more than others. They mainly affect the coronary arteries with the consequence of ischemia and myocardial infarction. The brain vessels are also very often affected, where their closure, or the hemorrhage from a ruptured artery causes distraction of the brain tissue. A branch of the medial cerebral artery is often affected and is known as Charcot artery of the sudden death, that supplies that part of the brain through which the main pyramidal tract is passing. Due to ischemia or due to hemorrhage in this region there will be a resulting hemiplegia - which is a plegia that affects the contra lateral half of the body. As a result of vascular injury in the eye there will be some degenerative changes on the retina (hemorrhage and exsudates), with the possibility of its ablation – ablatio retinae. From the practical point of view the retinal blood vessels can be subjected to examination and so they can provide us with valuable information about the state of the brain vessels.

Due to the injury of renal blood vessels there might be degeneration of the renal parenchyma, nephrosclerosis resulting in worsening of the hypertension. If the renal injury exceeds a certain limit, the kidneys stop to perform their basic function and uremia develops.

3.14.1.5 Complications of hypertension

The prognosis of patients with EH depends on the early diagnosis, on the appropriate treatment, and on the speed of development of atherosclerotic changes in the arterial system and on the secondary injury of individual organs. Nearly 20 % of patient having so called juvenile hypertension (the increase of blood pressure in the age of 15–18 years) turns to become a chronic hypertension in the adulthood. Basically we may say that at present we do not know how to treat essential hypertension. Today's therapeutic possibilities however have essentially improved the prognosis in patients because they delay the occurrence of organic complications and life is prolonged in 80–85 % of the patients.

In about 15–20 % hypertensive patients the illness is resistant to the therapy and the progression of the organic complications is proceeding and here occurs an accelerated or malignant hypertension. It is characterized by a continuous elevation of the diastolic blood pressure over 130 Hg prominent changes in the retinal blood vessels, fast progression of the renal insufficiency, some predisposition for encephalopathic

attacks and for the development of left ventricular insufficiency.

The occurrence of complication markedly affects the prognosis of the patients. The acute complication might be hypertensive crises – being a sudden raise of the blood pressure over the values 220/130 Hg and a fast development of the signs and symptoms of hypertensive encephalopathy: severe headache, nausea and vomiting, epileptic convulsions, aphasia, disorientation, somnolence, and finally coma. The opthalmoscopic examination reveals papillary oedema and retinal hemorrhages and exudates. The morphological substrate of this syndrome are multiple thrombi in the small cerebral arteries and brain oedema. The main reason for the occurrence of hypertensive encephalopathy is the failure of the normal autoregulatory mechanism of the cerebral blood flow. It was found out that as a result of the high blood pressure in the systemic circulation in the hypertensive patients there will not be an autoregulatory conditioned drop of the cerebral blood flow, but on the contrary, the cerebral blood flow will be increased.

This will increase the capillary hydrostatic pressure and as a consequence there will be an increase of transudation of fluid from the intravascular space into the interstitium and by this mechanism cerebral oedema occurs. Since the brain is enclosed in an unexpandable skull, the capacitance blood vessels are compressed as a result of additional transudation of fluid into the interstitium. These changes in interstitial space will compress the cerebral capillaries and therefore the blood flow via the brain decreases. The wall of the cerebral arterioles that are affected by the atherosclerotic changes and thickened become poorly adaptable to the changes of the systemic blood pressure. At the physiological conditions an increase of the systemic blood pressure induces vasoconstriction, whereas the decrease of the systemic blood pressure causes vasodilatation of the cerebral blood vessels. Brain hypoxia occurs in he normotonic people when the mean arterial blood pressure is 40 mm Hg (5,5 kPa), and in hypertonics when the pressure is 70 mm Hg (9,3 kPa). The hypertensive patient is not able to respond to the hypercapnia and acideamia in the cerebral vessels by vasodilatation and can not respond to hypocapnia and alkalosis by vasoconstriction as well, as it is in physiological conditions. The relative hypercapnia and cerebral hypoxia with the corresponding changes of the brain haemodynamic

can explain the characteristic morning headaches in the hypertensive people. The serious life threatening complications of the essential hypertension can be:

- left ventricular failure leading to pulmonary oedema

- acute myocardial infarction

- cerebral hemorrhage

- dissection aneurysm of the aorta

- progressing renal insufficiency.

3.15   Secondary arterial hypertension

The secondary hypertension usually accompanies diseases of the kidneys, cardiovascular system, endocrine and nervous systems.

3.15.1   Renal hypertension

It occurs as a result of the primary injury of the functional renal parenchyma – nephrogennic hypertension, or it is due to some anomalies and changes of the renal vasculature – renovascular (vasorenal) hypertension. The pathogenesis of the arterial hypertension is in those patients explained by two mechanisms: volumetric or resistance.

3.15.1.1   Injury of the renal parenchyma

Hypertension during parenchyma injury is one of the most common types of the secondary hypertension. An increased blood pressure is mostly the first sign of the original renal disease.

One of the pathogenic factors to which is related the cause of the occurrence and the maintenance of the hypertension is a drop in the Na^+ excretion. The increased volume of the circulating blood will lead to an increased venous return into the heart. That is why the central venous pressure is increasing and the ventricular filling is increased as well. As a result of