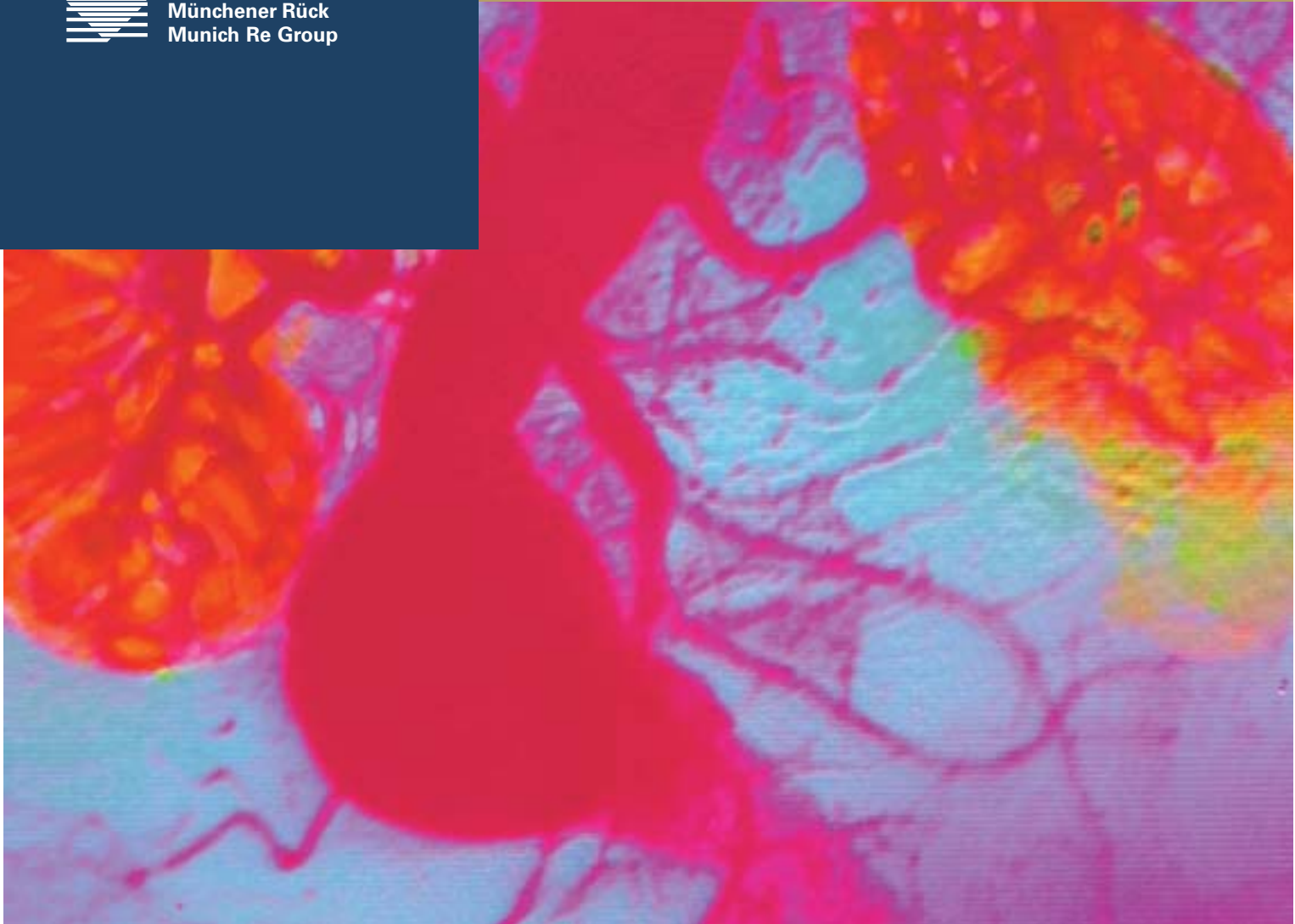


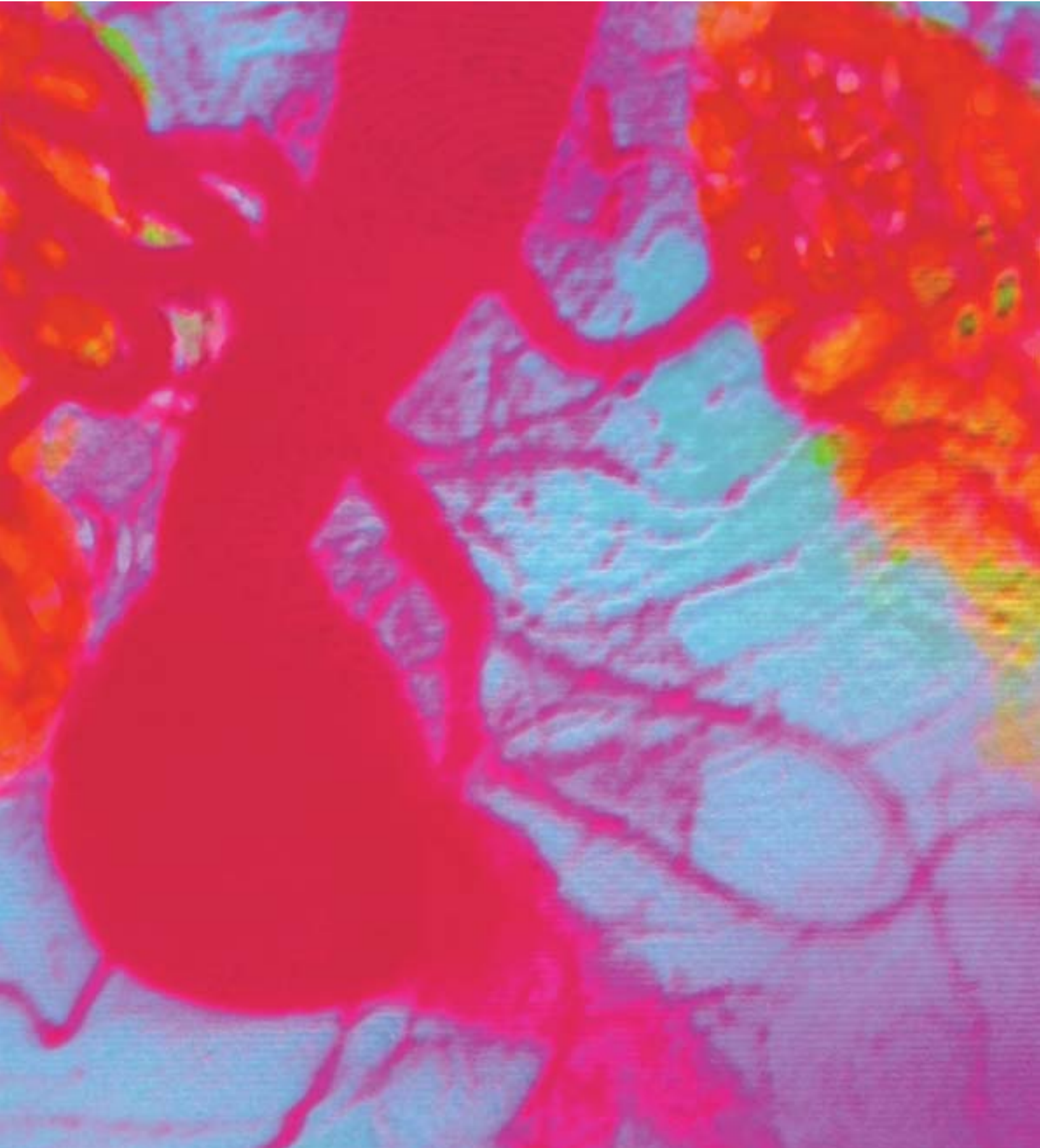
November 2004

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Münchener Rück
Munich Re Group





Radiological demonstration of the blood vessels (angiography) shows a widened aorta after many years of hypertension (abdominal aortic aneurysm). Patients with high blood pressure have an increased risk of developing an aortic aneurysm – with the danger of life-threatening rupture of the vessel.

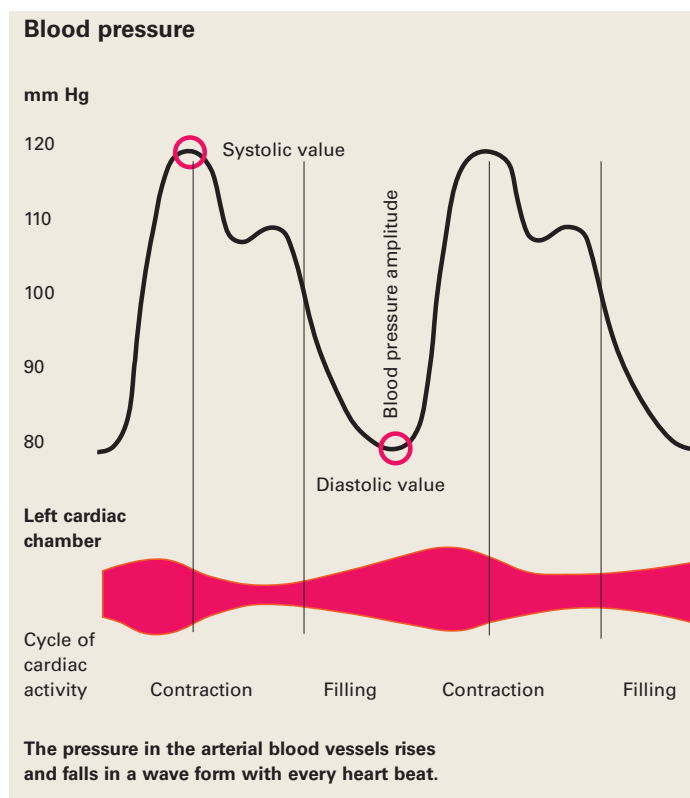
About half of the population in Europe is afflicted with high blood pressure. If left untreated, the disease leads to serious organ changes that often become apparent only after years or decades. High blood pressure does not cause pain, yet it accounts for the most common causes of invalidity and death. In most instances, however, an effective treatment that could prevent dangerous long-term consequences would be possible.

Blood pressure – Not a new, but an important issue

In order for blood to circulate throughout the body, a certain pressure must be present in the blood vessels. This pressure comes from the heart: each heart-beat creates a pressure wave that is continued throughout the arteries. The heart pumps blood in waves into the arteries, where it turns into a continuously flowing bloodstream.

Blood pressure – The basics

The pressure in the arterial blood vessels is called blood pressure. It rises and falls in waves during each heartbeat. The highest pressure is achieved during contraction of the heart muscle (systole), the lowest during the relaxation of the heart (diastole). These two values make up what is called the systolic and diastolic blood pressure and are always given together, for example, as 120/80. Blood pressure is measured in millimetres of mercury column (mm Hg). The level is dependent on the blood volume, the resistance in the vessels, and the force with which blood is pumped into the circulation by the heart.



Borderline values

The upper blood pressure limit of normal in adults is 140/90 mm Hg. But even values that lie slightly below this value – between 120 and 140 systolic pressure – may present a higher risk for cardiovascular disease. The ideal blood pressure is therefore around 120/80 mm Hg, or less.

Measurement

An inflatable rubber cuff is placed around the upper arm and inflated with air until the artery is completely compressed. Blood no longer flows once the pressure in the cuff exceeds that in the artery of the arm. Then air is slowly released from the cuff. The physician simultaneously listens to the artery in the bend of the elbow, using the stethoscope. As soon as the pressure in the tourniquet falls below the maximum pressure in the artery, blood starts to flow again. With the stethoscope, one can then hear the heartbeat. The doctor notes the pressure in the cuff as the systolic pressure. When the pressure in the cuff falls below the diastolic blood pressure, the heartbeat can no longer be heard. This then signifies the blood pressure of the relaxed heart.

Modern instruments for automatic blood pressure measurement often use oscillometry, i.e. electronic measurement of oscillations. Instead of registering heartbeat sounds, the instrument registers vibrations to the cuff during the release of air, and uses these to determine the blood pressure values.

Errors during blood pressure measurement

In theory it is simple, but in practice false values are common. What are the typical stumbling blocks?

Size of the cuff

If the cuff is too narrow, systolic values obtained will be too low and diastolic values too high.

Rest period before blood pressure measurement

At least five minutes of rest must be given before measurement, otherwise the blood pressure values obtained could be too high.

Cuff inflation

If the cuff is not sufficiently inflated, the systolic value will be determined too low.

Cuff at height of heart

For every 10 cm deviation above or below, the value of blood pressure obtained will rise or fall by 8 mm Hg. This error occurs particularly easily during self-measurement with devices at the wrist.

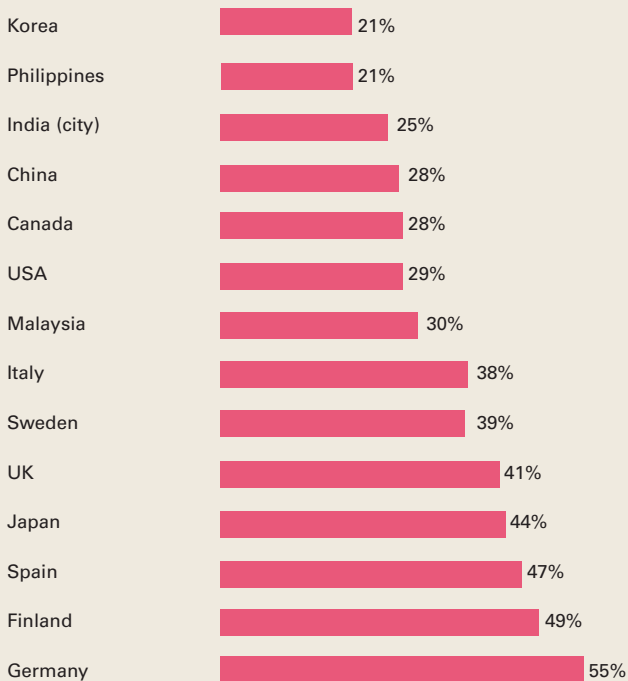
The individual daily form can also influence the blood pressure. Because of a full bladder or pressure on the bowels, the blood pressure can be elevated by 20 to 30 mm Hg. Blood pressure can also be too high if the person being measured speaks during the measurement, or if he or she consumed coffee, alcohol or nicotine beforehand.

Widespread

Hypertension is truly a widespread disease. The proportion of people affected increases with age. Men suffer from high blood pressure more often than women.

Measured against the upper limit of normal of 140/90 mm Hg, about 44% of the population in Europe are affected by elevated blood pressure. The graph below demonstrates that people living in the USA and Canada are less at risk in comparison to Europeans. According to recent studies, only 28% of the population in those countries are affected by hypertension. The reasons for this have not yet been investigated. With the exception of Japan, most of the Asian countries are at the relatively low level of the USA and Canada, with some large differences between urban and rural regions.

Proportion of the population with high blood pressure



Sources: Wolf-Maier K, Cooper RS, Banegas JR et al., 2003
World Health Organization

Causes

In about 90% of all patients with hypertension, no direct cause can be found. This is referred to as primary or essential (due to predisposition) hypertension. There is often an underlying genetic disposition. Whether or not the genetic disposition actually leads to hypertension is, however, determined by external factors such as obesity, lack of exercise, alcohol, stress, and excessive consumption of salt.

The remaining 10% of affected people suffer from secondary hypertension. In this case an organic cause is present. The most common triggers are kidney diseases or tumours.

Therapy

The prognosis of hypertension depends on an effective therapy. Long-term consequences can be avoided if a diagnosis is made early.

In primary hypertension, treatment depends on how high the blood pressure is, whether resulting damage has occurred, and whether further risk factors such as elevated blood lipids or smoking are present.

In secondary hypertension with organic causes, the treatment of these is of primary importance, for example the operation of a narrowed renal artery.

Drug treatment

Several drugs effectively lower blood pressure by regulating factors in the body that influence blood pressure: the tension of the blood vessels, the heart's efficiency to pump and the volume of fluid in the body. According to recent study results, most people require at least two different drugs to reduce the blood pressure to below the normal value of 140/90 mm Hg.

Non-drug treatment

How blood pressure develops depends on the lifestyle. If the blood pressure is only slightly elevated with no resulting damage, younger patients in particular should try to normalise their blood pressure without recourse to drugs. They should also avoid additional risk factors.

Weight reduction

10 kg less body weight can reduce the average blood pressure by 25/15 mm Hg. This has an additional positive effect on other risk factors such as diabetes and elevated blood fats.

Physical activity

About half of the people with hypertension react positively to physical training. The average reduction in blood pressure following a few weeks of endurance training is between 7 and 10 mm Hg.

Dietary salt restriction

The recommended limit of salt in the diet is 6g per day. Today, the average consumption per capita is at least twice as high. Three grams of salt less lowers the blood pressure by an average of 5 to 7 mm Hg. Restriction of salt intake is effective in only about half of all patients with hypertension, however.

Restriction of alcohol consumption

Chronic alcohol abuse frequently leads to high blood pressure. Less alcohol has a positive influence: the alcohol-related hypertension will normalise in 90% of all cases if the patient consumes less than 20g of alcohol per day.

White-coat or surgery-visit hypertension

It will occur quite frequently that the doctor will measure a higher blood pressure than the nurse, or the patient himself. Do the higher values in this case represent exceptions to an otherwise normal blood pressure, or is the blood pressure actually pathologically elevated?

The values that the patient has measured himself are not sufficient to answer this question, since people tend to only note down favourable values. Elevated measurement results are ignored – a form of denial and lack of acceptance of disease. To play it safe, ambulatory 24-hour blood pressure monitoring is the more efficient method.

Furthermore, organ damage due to elevated blood pressure should be checked: does the retina show signs of damage or is the heart muscle thickened?

If the result shows normal blood pressure beyond any doubt, the patient has hypertension as a reaction to the doctor's white coat or the stress of the surgery visit. This does not present a significant increase in risk.

Low blood pressure?

Low blood pressure or hypotension refers to systolic blood pressure values that frequently fall below 100 mm Hg. As with elevated blood pressure, one distinguishes between a primary and a secondary form.

Primary (essential) hypotension

This type is usually functional and dependent on predisposition (vasomotor instability). It affects young women in particular and is aggravated by stress. The afflicted have a tendency for collapsing, heart palpitations and cold extremities. This type of hypotension is harmless and is not considered pathological. Treatment is only necessary if it leads to complaints. Physical measures such as regular exercise or alternating cold-and-warm showers may help.

Even in people who exercise regularly, low blood pressure can be normal; the circulation is then thought to be in protective mode.

Secondary forms

These can be caused for example by hormonal imbalance such as a disturbance in the adrenal glands, or cardiovascular diseases (myocardial infarction, cardiac insufficiency).

Orthostatic hypotension or hypotonic circulatory dysregulation

When those affected stand up after lying down, they become dizzy and the blood pressure falls. This can, for example, occur in primary or secondary hypotension, but also with varicose veins and nerve damage (diabetic neuropathy) or after a prolonged period of bed rest.



Ambulatory 24-hour blood pressure monitoring (ABPM)

Traffic congestion, stress with the boss, too much coffee – our blood pressure is subject to tremendous influences in the course of 24 hours and reacts to them with considerable fluctuations. Until now, the diagnosis was often determined after several single measurements. Yet, experience shows that a single blood pressure measurement is only a momentary snapshot with very limited significance. A single measurement is therefore not sufficient.

But even with several single measurements, ambiguities remain. Do the prescribed drugs lower the blood pressure sufficiently over the course of the entire day? Do higher values only occur with the physician measuring?

These questions are answered by ambulatory 24-hour blood pressure monitoring – the long-term blood pressure. Blood pressure is measured every 15 minutes over the span of a 24-hour period. A small device on the patient regularly inflates the cuff and automatically measures the blood pressure. The patient is asked to note down which activities he is pursuing at the time and when he goes to bed. In this manner one can obtain a precise blood pressure profile.

24-hour blood pressure profile

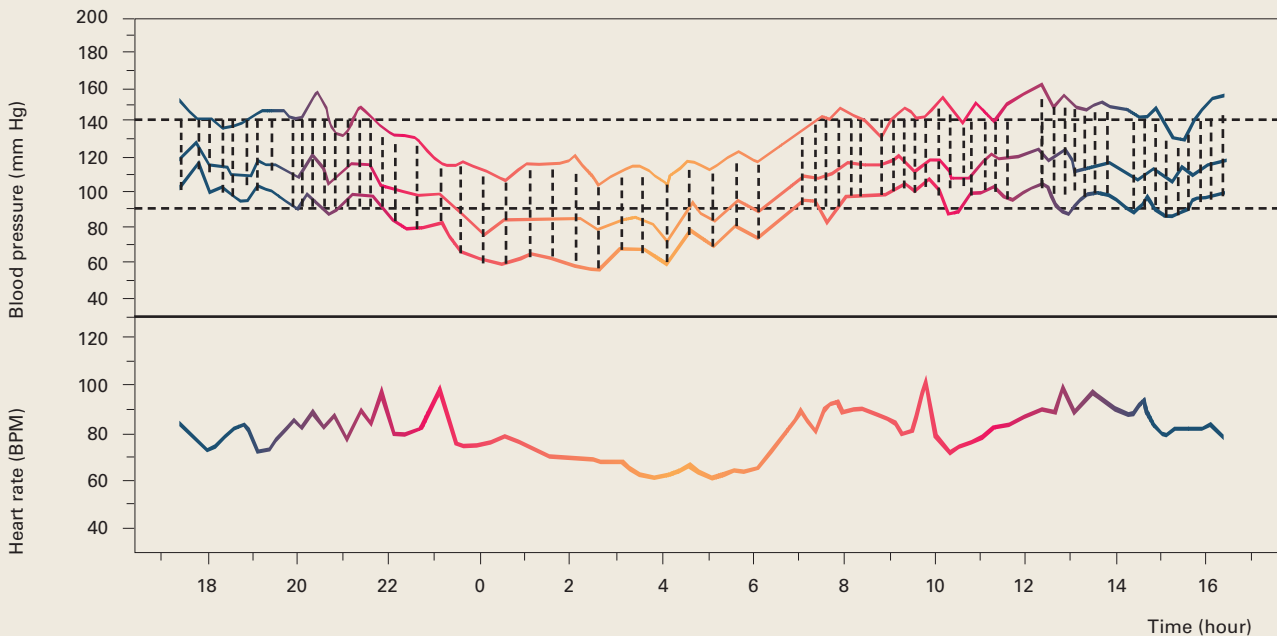
The significance of 24-hour blood pressure monitoring is clearly superior to the conventional single measurement due to the frequency of measurements throughout the entire day and night.

The following are considered normal values for long-term monitoring, and indicate whether the blood pressure is too high:

Value	Upper limits of normal (mm Hg)
Average daytime value	135/85
Average night-time value	120/70
Average 24-hour value	130/80

Source: Blood pressure measurement and diagnosis of hypertension. The German Hypertension Society, 1998

24-hour blood pressure



24-hour ambulant blood pressure measurement in a patient with mild hypertension. The upper lines show the systolic pressure (SBP), the mean arterial pressure (MAP) and the diastolic pressure (DBP). Below is the heart rate in beats per minute. The blood pressure falls considerably during sleep – normal night-time dipping.

For the diagnosis of hypertension, the average daytime value should be used, since the daytime values are more closely correlated to resulting damage. The so-called night-time decline is also important. Normally the average blood pressure falls at night during sleep by 10–20% compared with the average daytime value. If this drop is not present, or if the blood pressure rises, this can be an indication of an organic cause, for example renal disease.

Identical value, increased risk

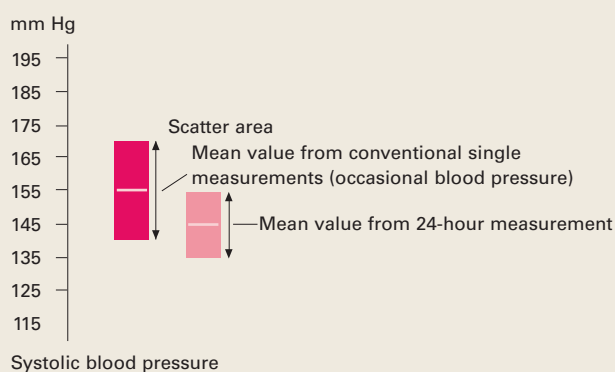
If an average daytime value of 150/95 mm Hg is measured during long-term examination, this translates to a higher risk than a comparable individual measurement. A current study by Munich Re shows that the values obtained from long-term examinations cannot be matched with conventional single measurements.

The 24-hour values are generally lower and lie closer together compared with single measurements. What is the cause for this? Statistics can provide an explanation. Mean values that are calculated from many regularly recorded values have a much smaller range of dispersion compared with individual measurements. Extremely small and extremely large values cancel each other out when calculating the mean value. And, the more measurements that flow into the calculation, the smaller the dispersion will become.

This is why the average values with long-term BP measurement are lower overall than those of single measurements.

We have developed a statistical model with which we can allocate the 24-hour mean values to the conventional rating system. This now enables a precise and uncomplicated assessment for 24-hour blood pressure values. For the quick daily rating MIRA has been updated.

The 24-hour measurement is more accurate



The scatter of the blood pressure values from the 24-hour measurement is smaller; the mean is lower. This has an effect on the blood pressure rates.



Ambulant blood pressure monitoring.

Exercise hypertension

When a weightlifter lifts weights, his blood pressure can rise to more than 300 mm Hg and his heart can beat up to 200 times per minute. These extremely high values are caused because the weightlifter is considerably tensing his muscles.

In order to supply active muscles with oxygen, the heart must pump a larger volume of blood into the body than when the muscles are supplied with blood at rest. For this reason, even healthy individuals have a higher blood pressure when they are exercising. The normal increase in blood pressure during physical activity is, however, not harmful. On the contrary, through regular exercise for the circulation the heart is relieved while at rest, and this lowers the resting blood pressure.

But some people react to physical activity with an extreme rise in blood pressure. This is referred to as exercise hypertension, which often leads to a true hypertension with all of its consequences.

The elevated values are usually detected during a stress ECG. Whether an excessive increase in blood pressure is present or not can only be determined at a sub-maximal strain of between 50 and 100 watts. Blood pressure values at the highest level of strain have no prognostic significance. The subject is not permitted to really exert himself.

The following table shows the values for the upper limits of normal for exercise hypertension. Blood pressure is evaluated at 100 watts. Should this strain lie close to the maximal exertion limit due to individual constitution (e.g. a light-weight woman, an elderly person), upper limits of normal values of 75 watts are used.

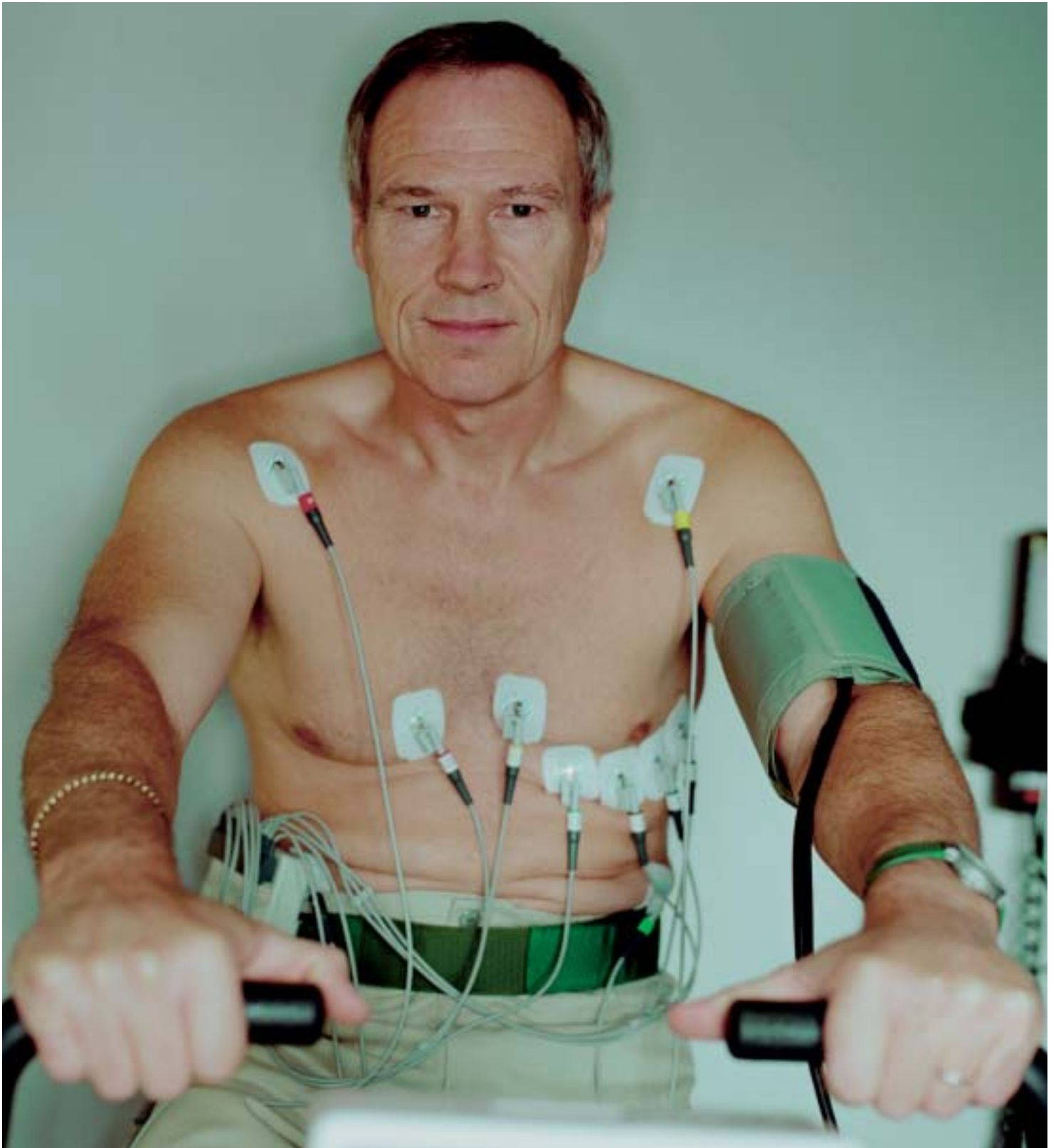
Limits for blood pressure on exercise

Age	Values for upper limits of normal (mm Hg)			
	75 W strain		100 W Strain	
	Systolic	Diastolic	Systolic	Diastolic
20–50	185	100	200	100
51–60	195	105	210	105
61 and over	205	110	220	110

Source: Franz IW, 1996

Exercise ECG

An exercise or stress ECG is often carried out on a stationary bicycle. The patient can sit or lie. The intensity of the loading is increased by 25–50 watts every two minutes. The investigator records the ECG and blood pressure at the end of each incremental load.



Relevance of hypertension for prognosis

It is not so long ago that “age plus 100” was generally accepted as the guiding formula for measuring a person’s normal systolic blood pressure. Today we know better: values in excess of 115/75 mm Hg are often linked to cardiovascular diseases, independent of age.

Consequences of hypertension

Without treatment, hypertension leads to high-grade organ damage. A high blood pressure is, therefore one of the most common treatable causes of invalidity and death. The following organs are particularly at risk:

Heart

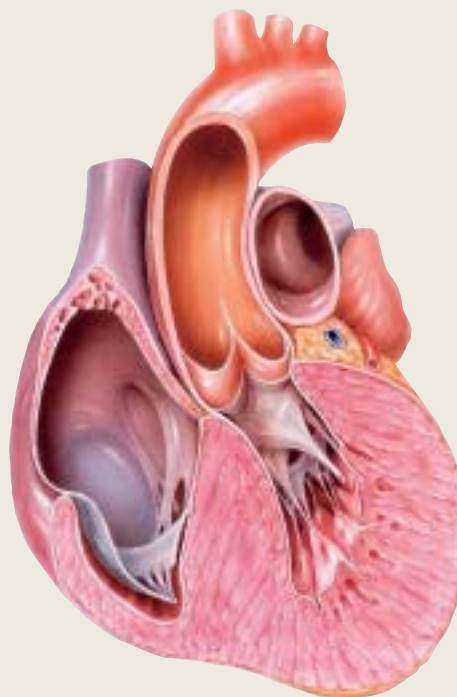
Arteriosclerosis in the coronary arteries causes so-called coronary heart disease (CHD). This can lead to severe chest pain (angina pectoris) or even a heart attack.

During hypertension the heart is continuously required to pump against the increased pressure. The left ventricle of the heart reacts by a thickening of its muscle (left ventricular hypertrophy, LVH). Ventricular hypertrophy is diagnosed with the help of echocardiography (“heart ultrasound”), through direct measurement of the thickness of the cardiac wall. An ECG can also provide clues that indicate hypertrophy, but its findings are less precise. Left ventricular hypertrophy increases the mortality and invalidity risk. If the blood pressure is reduced early and sufficiently, LVH can decrease again. On the other hand, without sufficient treatment the long-term outcome is cardiac insufficiency (heart weakness). The heart is then no longer capable of sufficiently supplying the body with blood.

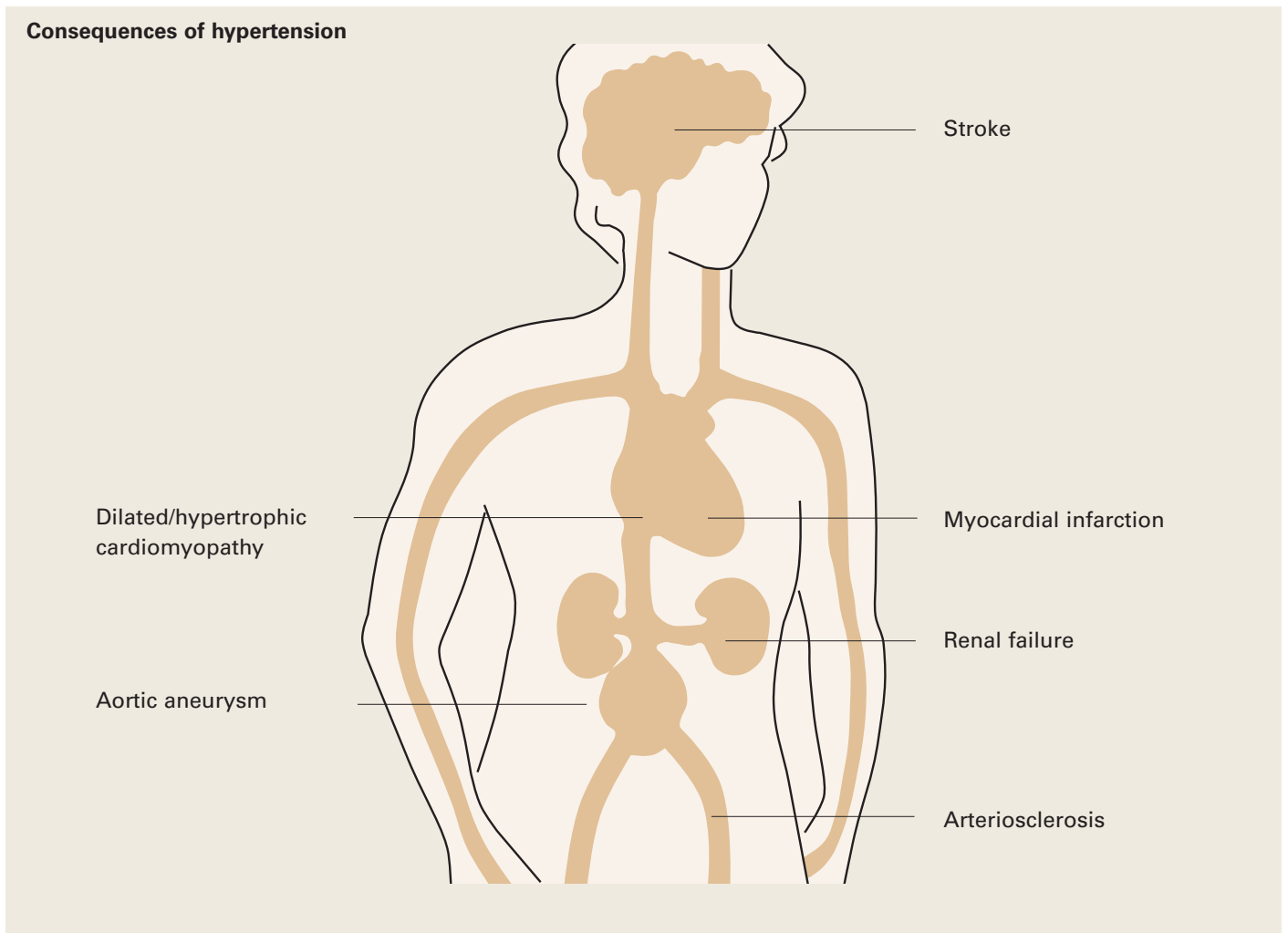
Arteries

When blood pressure is elevated in the arteries for a protracted period of time, the vessel walls change both structurally (so-called remodelling) and functionally. They thicken. Arteriosclerotic deposits build up on the interior wall of the blood vessels and cause a narrowing of the vessel. These plaques can also detach and wash away; this creates acute occlusions in the blood circulation. The extent of arteriosclerosis is also considerably influenced by other risk factors such as elevated cholesterol, diabetes and smoking.

Left ventricular hypertrophy



If the blood pressure is raised, the heart has to increase its performance. This causes permanent changes. The muscle wall of the left ventricle is greatly thickened and the apex of the heart becomes more rounded.



Degree of severity of hypertension

Classification	Systolic	Diastolic
Optimal	< 120	< 80
Normal	< 130	< 85
High-Normal	130–139	85–89
Hypertension (Grade 1: "mild")	140–159	90–99
Hypertension (Grade 2: "moderate")	160–179	100–109
Hypertension (Grade 3: "severe")	> 180	> 110

Age is irrelevant in terms of the degree of severity.

Source: WHO/ISH Guidelines Subcommittee, 1999

The artery (circle) in the leg of a patient with hypertension and diabetes shows high grade narrowing. The normal appearance of the opposite side can be seen on the right of the picture. Digital subtraction angiography (DSA), a radiological procedure, shows the blood vessels with particularly good contrast.

Lower extremity and pelvic arteries

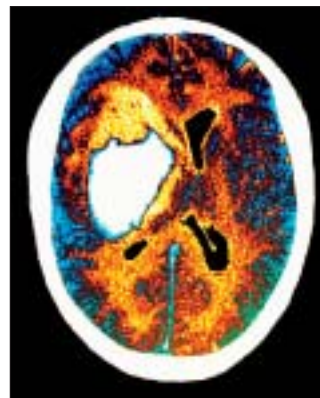
Hypertension also causes damage to the vessels of the lower extremities. An increase in the narrowing of the arteries of the lower extremities and pelvis is referred to as peripheral arterial occlusive disease (PAOD). It is also referred to as intermittent claudication of the leg or, in the German vernacular, "window shopping disease" (literal translation from German) because the affected person always needs to stop while walking due to the pain this incurs, giving him time to rest and gaze into shop windows.

Eyes

The elevated blood pressure also affects the small arteries in the retina. In comparison to the other vessels in the body, the physician can take a look at the retina without much trouble. The retina can act as a mirror of all the vessels in the body. Advanced stages of damage to the retina (Stages III – IV) are especially important. Other organs often also have vessel damage of similar severity.

Brain

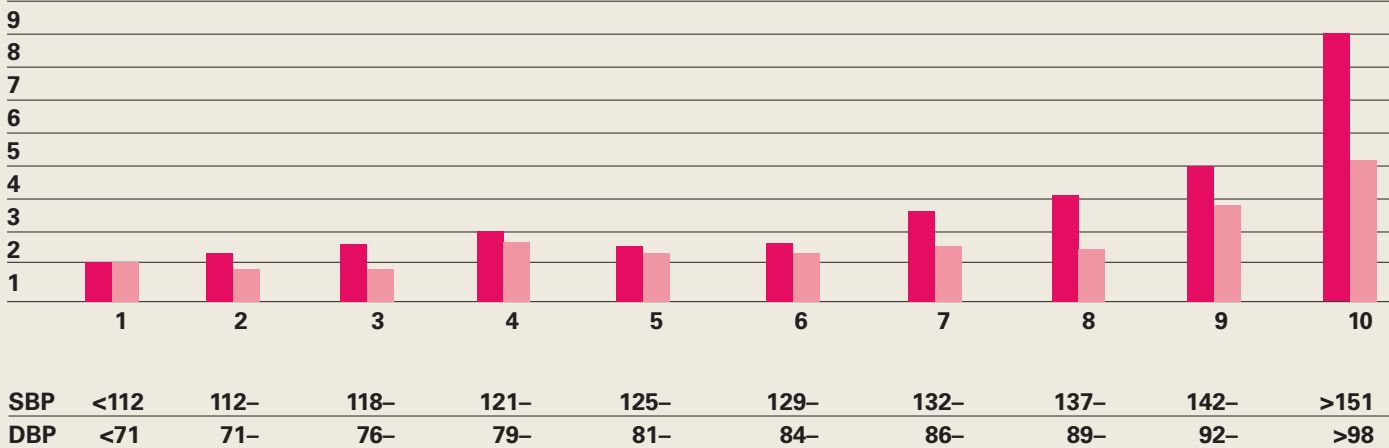
High blood pressure is the number one risk factor for the dreaded stroke. Strokes account for about 20% of all deaths, many affected suffer permanent brain damage. Stroke is the most common disease resulting in permanent disability.



Stroke. A CT (computer tomography) scan of the head shows a massive bleed (white) into the right half of the brain. This bleed into the right half of the brain would typically cause paralysis on the left side of the body.

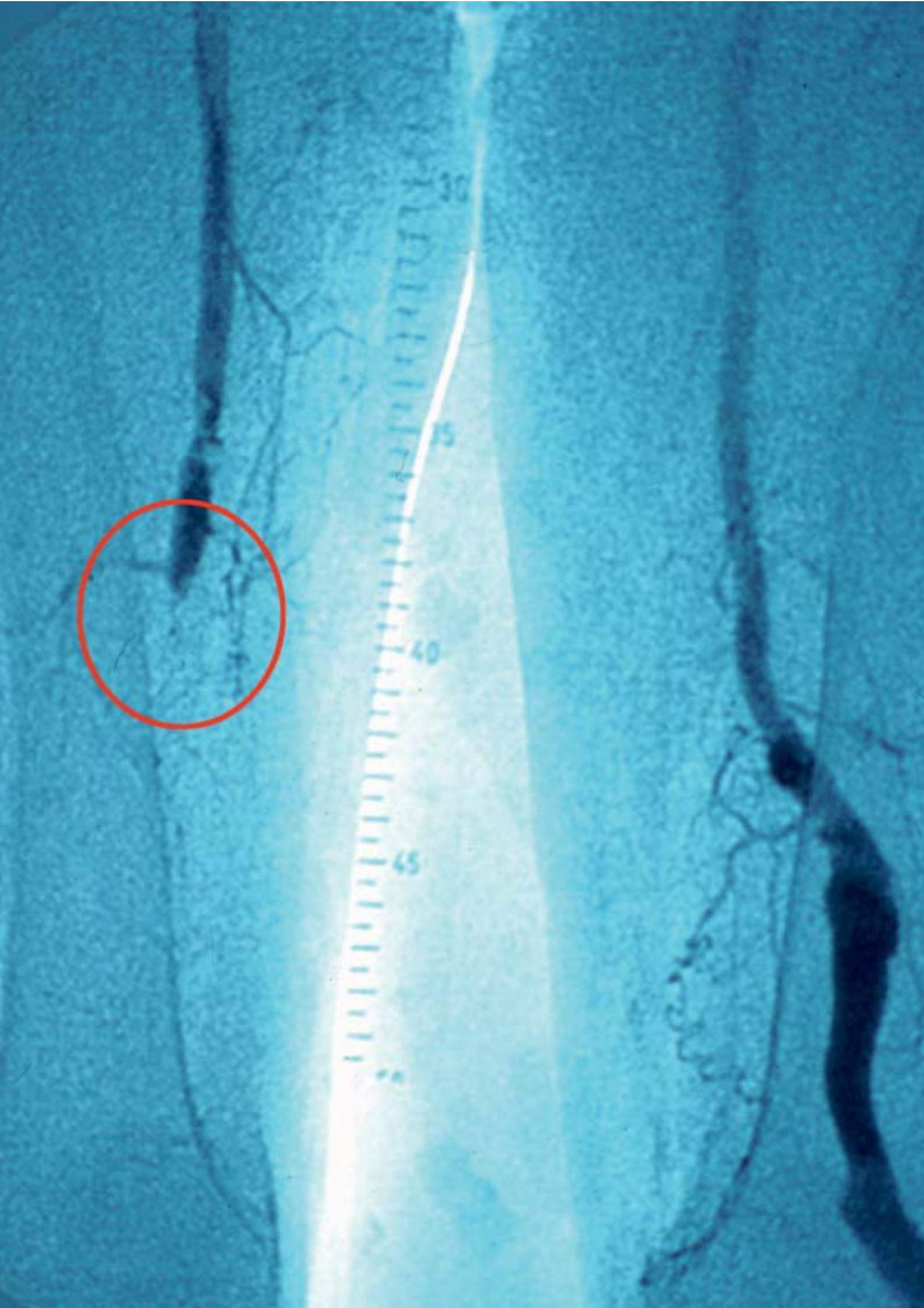
Death following a stroke

Relative risk of death from a stroke



The risk of dying as the result of a stroke increases with the severity of the hypertension.

■ Systolic blood pressure (SBP)
■ Diastolic blood pressure (DBP)



Expense factor hypertension

For a long time now, hypertension has reached epidemiological proportions throughout all industrial nations. Not only the direct costs of treatment are vast – expenditure for subsequent damage goes into the billions.

As measured against the upper limit of normal of 140/90 mm Hg, a third to half of the population is affected by hypertension. Elderly people above 65 are affected the most with a ratio of 70 to 80%, depending on the country.

However, at present only about half of the people with hypertension are taking blood pressure lowering medicine, and only 20 to 30% of them are optimally adjusted. An important reason for this is the poor patient compliance. Every second patient discontinues anti-hypertensive therapy after one year at the latest. This is due to the fact that, on the one hand, an elevated blood pressure does not cause any complaints initially and the patient feels healthy. On the other hand, side effects related to treatment can cause discontinuation, especially when they are not tolerated due to a lack of disease acceptance.

The trend is toward an earlier start of treatment. Numerous studies have shown that the risk of cardiovascular disease increases at blood pressure values of over 115/75 mm Hg. In the USA consequences have been drawn: the current treatment guidelines advise a change in lifestyle with blood pressure values above 120/80 mm Hg. If a patient also has age-related diabetes, current guidelines recommend adjusting the blood pressure to values much below the borderline of 140/95 mm Hg.

Furthermore, the population in most industrialised nations is ageing more and more. Specifically, elderly people are almost regularly affected by hypertension. This results in the fact that more blood-pressure-lowering medication is going to be prescribed in the future.

Large economic implications

The daily costs for blood pressure treatment range between €0.19 (Chlorthalidone) and €0.85 (AT1-blocker) per person for the individual drugs. More than half of the patients require at least two drugs. Annually that translates into an average of about €300 per patient. If all hypertensives in Germany were to receive consistent treatment, this would add up to a cost for blood pressure medication of €9bn per year.

A possible means of cost reduction was demonstrated recently by a large American study (ALLHAT) in over 40,000 patients. Treatment with the long-standing and comparably cheap diuretic Chlorthalidone has an equally efficient treatment outcome to the much more expensive drugs. Initial projections estimate that for the case of Germany alone half a billion euros could be saved if in 70% of all cases Chlorthalidone were substituted for the expensive drugs.

Hypertension and health insurance

The resulting damage and accompanying diseases of hypertension can create high costs for health insurance. A meticulous medical risk assessment is therefore essential.

It is possible to insure applicants

- with long-term well-adjusted blood pressure;
- in whom secondary hypertension has been excluded or at least is unlikely;
- without resulting impairments (e.g. normal retina, normal urinary findings, no indication for arteriosclerosis).

Caution is required with

- the coexistence of other risk factors for cardiovascular disease. A particularly common combination is the additional presence of obesity, elevated blood fats, high levels of uric acid or a disturbance in the glucose metabolism (pathological glucose tolerance or diabetes mellitus). This is called the metabolic syndrome. Smoking poses an important additional risk. Each additional risk factor greatly increases the probability for subsequent cost-intensive complications, such as heart attack and stroke;
- insufficiently treated, poorly adjusted and considerably fluctuating blood pressure;
- poor compliance (patient collaboration);
- left ventricular hypertrophy (LVH, thickening of the heart muscle);
- pathological urinary findings, in particular proteinuria (protein in the urine). This could indicate secondary hypertension due to renal impairment or (more rarely) renal damage resulting from hypertension.

It is not possible to insure hypertensives with

- chronic renal impairment;
- diabetes mellitus;
- high-grade retinal changes (Grades III and IV);
- resulting arteriosclerotic damage (e.g. coronary heart disease, cerebral and peripheral circulatory disorders);
- malignant hypertension.

For balancing risks with hypertension, only loadings are suitable. Disqualification from benefits cannot be recommended due to the problem of discrimination in the event of a claim.

New insights from risk assessment: Revised blood pressure evaluation by Munich Re



Dr. Achim Regenauer, Chief Medical Director at Munich Re, talking about current revisions to high blood pressure in the MIRA reference manual.

Medletter: Hypertension is a well-established risk factor. Was anything new to be expected?

Dr. Achim Regenauer: High blood pressure is one of the most important risk factors for cardiovascular disease and almost half of the population is affected. Especially in the last few years, several new studies have been published which show how high blood pressure can be treated. Furthermore, applications usually contain records of 24-hour blood pressure monitoring or echocardiography.

Medletter: What work was required?

Regenauer: We analysed numerous scientific publications, among them the extensive Framingham Data or the huge MRFIT Study with over 360,000 participants. Elevated risk examinations from insurance records were also included in our evaluation.

Medletter: Is there a particularly interesting aspect to your findings?

Regenauer: We were taken by surprise by the 24-hour blood pressure monitoring. An important outcome was that the mean values gathered from long-term measurement should not be assessed according to standard blood pressure tables. This is why we have developed a statistical model in which the 24-hour mean values can be allocated to new rating tables.

Medletter: ABPM has been around for many years. Why has your new development not been introduced before now?

Regenauer: As with all new methods used in medicine, we first need to attain a safe level of research and scientific consensus before results can be incorporated into medical insurance appraisals. The studies that formed the basis of our statistical model were only published in the last two years, for example.

Medletter: What additional new insights have you gained?

Regenauer: We will be more prudent with very high blood pressure values, for in these instances rapid severe consequences have to be expected. For younger age groups we have attempted a more refined prognostic gradation of diastolic blood pressure values. In order to evaluate exercise hypertension, rules now exist that are simple to apply. Men and women are now treated in the same way. This can be deduced, for example, from the results of the Framingham Study. Lastly, we have revised the evaluation criteria for blood-pressure-related retinal changes and drawn up a table for normal values in children.

Medletter: One, two or multiple drugs. Does that make any difference?

Regenauer: The far greater part of the prognosis is determined on the basis of measured blood pressure values. The number and type of medications are less important. In the future, specific loadings are going to be reduced for blood pressure medicines in life insurance policies.

A case report in practice



Case report

42-year-old high school teacher, Hubert K.

Desired insurance:

Life insurance and disability insurance

Five years ago, the primary care physician diagnosed an elevated blood pressure of 160/100 mm Hg for the first time. With the use of beta-blockers, the blood pressure was adjusted to values at around 130/85 mm Hg. During a doctor's visit six months ago, the primary care physician measured a value of 158/98 mm Hg once again. Meanwhile, Mr. K. had discontinued the use of his medication independently. His reason for this: "My measurements consistently indicate normal blood pressure." The primary care physician ordered ambulatory 24-hour blood pressure monitoring due to the discrepancy in results. The evaluation resulted in the following values:

– 24-hour total mean value	138/88 mm Hg
– Daytime mean value	141/93 mm Hg
– Night-time mean value	127/76 mm Hg

Mr. K. is slightly obese (BMI = 29 kg/m²). Since no other risk factors are present, his doctor thinks that a reduction in weight and a further observation of blood pressure would suffice for the time being.



Our rating is as follows:

Life: Extramortality + 25%

TPD own: +25%

TPD any: 0%



Commentary

Self-measurement is only of limited use, since people tend to note only the favourable values and to ignore higher values. Furthermore, errors in measurement through inaccurate application can also not be excluded. In addition, the upper limits of normal are lower for self-measured values, similar to 24-hour values. The results of the current 24-hour blood pressure monitoring are crucial for the evaluation of this case, in particular the mean daytime value. One should not refer to conventional rating tables as a comparison, since they have been calculated on the basis of single measurements. We recommend using the updated MIRA calculator.

Did you know ...?

> Who was Riva-Rocci?

The Italian physician Scipione Riva-Rocci invented the method normally used today for measuring blood pressure in the upper arm. In some countries the medical abbreviation "RR" for blood pressure is still used for this reason.



Historical representation of Hales' experiment on blood pressure. A glass tube was inserted into the carotid artery of a horse and the assistant measured how high the blood rose in the glass tube – up to a height of 9 feet.

Riva-Rocci was an assistant physician in Turin and around the year 1890 he started to develop a painless way to measure blood pressure. His first device consisted of a bicycle tube that he employed as a cuff for the upper arm. He inflated it using a rubber balloon and measured the pressure with a mercury barometer. Initially, many physicians were sceptical, since they trusted their own tactile senses more than a newfangled measurement device.

> When was blood pressure measured for the first time?

The first time, blood pressure was measured on a horse. The English naturalist Stephen Hales used a glass standpipe that was directly hooked up to the animal's circulation.

> "The Framingham Study shows..." What is this study about?

Framingham is a small town in Massachusetts, USA. Since 1948, a part of the population there is being studied within a large-scale trial for cardiac diseases and various risk factors. The results are evaluated every two to four years. The Framingham Study has laid the foundation for many of the insights of modern medicine. Previously, it was believed that arteriosclerosis was a sign of old age which could not be influenced and that high blood pressure in old age is normal and necessary to pump blood through the narrowed blood vessels.

> The power of three hearts and yet a low blood pressure?

Octopuses have three hearts. Despite this elaborate provision, the blood pressure of these animals that are thought to be particularly intelligent is low in comparison to humans. Why is that?

Only one heart (the main one) supplies the body with blood. The other two pump the blue-coloured blood through the gills.

> Is dementia a consequence of high blood pressure?

Dementia, an acquired form of weakened intelligence due to brain disease, rises acutely with age. It is rarely seen in those less than 70 years of age, but between the ages of 80 and 85, 20% are affected, with 40% affected in those above 90. Causes are Alzheimer's disease and disturbances in circulation in the brain. Many studies have proved that high blood pressure promotes the development of dementia. The comparison of groups that had normal or elevated blood pressure values in middle age and were not treated showed that hypertensive patients must anticipate mental impairment in old age to a greater degree. In addition, they have a significantly higher risk of suffering a stroke. The studies also prove that blood-pressure-lowering treatment can considerably reduce the risk of dementia.



Octopuses have eight tentacles, three hearts, and blue blood flows in their blood vessels.

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