Lisinopril is a peptidyl dipeptidase inhibitor, an enzyme which participates in the conversion of angiotensin-I to the vasoconstrictor substance angiotensin-II. Angiotensin-II constricts blood vessels, which increases blood pressure, and Lisinopril works by preventing the formation of angiotensin II, which prevents the narrowing of blood vessels. The group of drugs where lisinopril belongs is called angiotensin converting enzyme inhibitors (ACE inhibitors).

Because of this effect, lisinopril is used in the treatment of hypertension, cardiac insufficiency, myocardial infarction and renal complications of diabetes mellitus.

**When Lisinopril should not be used**

It is absolutely contraindicated if you are allergic to this medication or if you have or have ever had angioedema (swelling of the skin, mucous membranes and tissues beneath the mucous membrane).

It is also absolutely contraindicated during pregnancy because it can cause malformations.

**When you need to be cautious**

Lisinopril may cause symptomatic hypotension (low blood pressure), especially in patients who already take other anti-hypertensive medications (diuretics, for example), or in patients who are dehydrated for some reason.
If hypotension occurs, the patient should be placed in the supine position and an intravenous infusion of normal saline should be immediately applied. After recovery, the patient can continue with the therapy.

In patients with heart failure who have normal blood pressure, this medicine may cause hypotension. This side effect, does not require interruption of therapy.

It should be used very cautiously in patients who have mitral valve stenosis (difficulty emptying the left atrium into the left ventricle, which causes shortness of breath and other symptoms).

Patients who have kidney problems should first take a laboratory test (creatinine clearance), and depending on the results, the doctor will determine the dose. In this way, the risk of adverse reactions will be reduced.

It is recommended that the amount of potassium in the blood is measured before starting Lisinopril therapy, as this medicine may cause hyperkalemia (high levels of potassium in the blood). The increase in the concentration of potassium in the blood can cause serious disorders of the heart rhythm. Therefore, you need to avoid foods rich in potassium (pumpkin and banana) while you are being treated with this medication.

It can rarely cause angioneurotic edema. When it occurs, it usually covers the face, limbs and tongue. Rare cases of fatal outcome caused by angioneurotic edema have been reported.

Also, this medication can cause liver failure, although it occurs very rarely. Tell your doctor if you notice a yellow skin color.

This medicine may cause a decrease in the number of red blood cells (erythrocytes), white blood cells (leukocytes) and platelets (thrombocytes), but these reactions are reversible, which means that the number of blood cells normalize after discontinuation of the therapy. A decrease in the number of red blood cells leads to anemia, a decrease in the number of leukocytes leads to immunity decline and a decrease in the number of platelets leads to blood clotting disorders.

This medicine can often cause a cough that is dry and persistent and is resolved after the therapy has been discontinued.

In diabetics, taking oral anti-diabetics or insulin blood glucose levels must be closely monitored, especially during the first few months of taking Lisinopril.

**Lisinopril and its use during pregnancy and lactation**

It can cause congenital malformations and therefore should not be used during pregnancy. The FDA has classified this drug in group D (drugs proven to cause malformations).

Instead of Lisinopril, other antihypertensive drugs (e.g. methyldopa) should be used during pregnancy.

There is insufficient data on its safety during breastfeeding.

**How should you take Lisinopril?**

It is mostly used once a day and always at the same time of day. Food has no effect on its absorption, and it can be taken with a meal or on an empty stomach.
Dosage is individual and should be determined on the basis of blood pressure, potassium levels in the blood as well as creatinine clearance values (in people with kidney problems).

<table>
<thead>
<tr>
<th>Condition</th>
<th>Recommended dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>High blood pressure</td>
<td>The starting dose is 10 mg a day and can be increased to 20 mg if necessary. Patients with renal insufficiency should start treatment with a lower dose, otherwise symptomatic hypotension may occur.</td>
</tr>
<tr>
<td>Cardiac insufficiency</td>
<td>It is usually applied in combination with a diuretic, and the starting dose is 2.5 mg daily. It may be gradually increased to a maximum of 35 mg daily.</td>
</tr>
<tr>
<td>Acute heart attack</td>
<td>The treatment begins within the first 24 hours of the onset of heart attack symptoms and lasts only for a couple of days. The starting dose in treating heart attack is 5 mg daily.</td>
</tr>
<tr>
<td>Renal complications of diabetes mellitus</td>
<td>The initial dose is 10 mg daily and the maintenance dose is 20 mg per day.</td>
</tr>
</tbody>
</table>

It can be applied in the treatment of hypertension in children aged 6 - 16 years.

**Taking Lisinopril with other medications**

The following medications should not be used while you're on treatment with Lisinopril:

- Lithium. If you take Lithium and Lisinopril together, toxic effects of lithium may occur.
- Medications that ease pain and inflammation, such as:
  - ibuprofen
  - flurbiprofen
  - ketoprofen
  - diclofenac
  - acetylsalicylic acid (*aspirin*)
  - celecoxib and others
  These medications can reduce the effects of Lisinopril.
- Gold preparations. Taking these medicines concurrently can lead to the nitritoid reaction (*dizziness, low blood pressure, dilation of blood vessels and severe nausea*).
- Tricyclic antidepressants, such as:
  - amitriptyline
  - nortriptyline
  - desipramine
  - imipamin
  These medicines may increase the blood levels of Lisinopril which results in a massive reduction in blood pressure.
- Phenylephrine, pseudoephedrine (*including nasal spray forms*) and other sympathomimetics. These medications reduce the Lisinopril efficacy.

Above are listed only some of the most commonly used medications that can interact with Lisinopril. Be sure to tell your doctor about all the medicines you are taking.
Side effects

The following side effects have been reported while taking Lisinopril:

1. Reducing the number of red blood cells (anemia)
2. Reducing the number of leukocytes (leukopenia) and consequently immunity decline
3. Reducing the number of platelets (thrombocytopenia) and consequently blood clotting disorder
4. Hypoglycemia (low blood sugar)
5. Mood swings, including depressive symptoms
6. Vertigo
7. Faster heart rate than normal
8. Raynald’s phenomenon
9. Dry, nonproductive and persistent cough
10. Hepatic insufficiency
11. Hair loss
12. Pemphigus (autoimmune disease of the skin)
13. Myalgia
14. Arthralgia
15. Renal dysfunction
16. Gynecomastia
17. Impotence
18. Angioedema
19. Asthenia (chronic exhaustion)
20. Hyperkalemia

Cough

The mechanism that leads to the cough is still unknown, and the incidence of cough as an adverse effect is high (5 - 35 %)\(^1\). Cough linked to Lisinopril is dry and persistent, and sometimes patients must discontinue therapy because the cough becomes intolerable and unbearable. If it is not possible to discontinue Lisinopril therapy, then the cough can be treated with drugs, such as: theophylline, baclofen or cromolyn.\(^2\)

When to see a doctor

If the cough lasts longer than three weeks.

Dizziness

Dizziness occurs because the blood vessels, including those in the brain tissue, expand which affects the center of balance located in the brain. Dizziness occurs frequently when you take the first pill of Lisinopril and besides the cough, is the most common reason for discontinuation of therapy.\(^3\) Don't drive a car or other motor vehicles if you are experiencing dizziness.

When to see a doctor

If dizziness does not stop after 10 days.
Hyperkalemia

Hyperkalemia is considered a serious adverse effect because it can lead to heart rhythm disorders and even to death! Because of that, doctors often discontinue the therapy. In one study conducted in the United States on several hundred patients taking Lisinopril and other ACE inhibitors, it was found that moderate hyperkalemia occurs in 20% of patients, while severe hyperkalemia occurs in 0.8% of patients. Concomitant use of diuretics (spironolactone, triamterene and amiloride), heart failure, and renal impairment are the risk factors for hyperkalemia.

When to see a doctor

If you notice symptoms such as: numbness of the fingers, chest pain, feeling a strong heartbeat in the chest or irregular heartbeat, you should immediately go to the nearest hospital. Normal range of potassium in the blood can range from 3.5 to 5.2 mmol / L. Hyperkalemia is considered to be mild if the potassium levels are 5.2-5.5 mmol/L, and severe hyperkalemia is considered if the potassium blood levels are higher than 5.5 mmol/L. Given that there is little difference between mild and severe hyperkalemia, it is necessary to regularly control the levels of potassium in your blood while you are on treatment with Lisinopril.

What measures to take to reduce the risk of hyperkalemia?

- Avoid foods rich in potassium (potatoes, tomatoes, banana and pumpkin).
- Regularly check your potassium levels in the blood (the first month) potassium levels should be checked every week, and then once or twice a month

Leukopenia

Leukopenia is a decrease in the number of leukocytes (white blood cells) in the blood. Decreasing the number of leukocytes can be huge (and that is called agranulocytosis), which can seriously affect the immune system, considering that leukocytes are immune cells that form the backbone of the immunity.

When their number is reduced, your immunity is weakened which makes your body more susceptible to infections (infections can even be caused by bacteria that are normally found in the body).

When to see a doctor

If you notice symptoms of the common cold or the flu (cough, sore throat, fever and malaise).

What measures to take to reduce the risk of leukopenia?

- Regular laboratory tests (once a month)

Anemia

Anemia occurs because Lisinopril and other ACE inhibitors prevent the synthesis of erythropoietin - a hormone that is responsible for the synthesis of red blood cells. Reducing the number of red blood cells means you have anemia. Anemia occurs more frequently in people who have kidney
problems.

**When to see a doctor**

- If you feel fatigue that lasts for days
- If you have unusually pale skin color
- If you are experiencing numbness in the fingers

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**What measures to take to reduce the risk of anemia?**

- Eat foods rich in iron and vitamin B12

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**Hypotension**

Since Lisinopril is used to treat high blood pressure, it is logical that sometimes you may exhibit more potent effects and lower blood pressure below the normal range. Hypotension can occur if you get up quickly from a lying position. The risk of hypotension is higher if you are dehydrated.

**When to see a doctor**

If you experience chest pain or palpitations.

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**Angioneurotic edema**

Angioneurotic edema occurs very rarely (incidence ranges from 0.1% to as much as 6%) and is more common in women than in men. People who smoke have a higher risk of angioedema. Although it occurs rarely, it can have serious health consequences, including fatal outcome. Fortunately, most often angioneurotic edema occurs in a mild form (it gets only to the face and tongue) and very rarely gets to the throat and lungs. Therapy includes discontinuation of Lisinopril and application of antihistamines.

**When to see a doctor**

If you notice swelling of the face, arms, legs or tongue.

Among above listed side effects, Lisinopril can also cause:

1. Muscle cramps (*result of a high potassium*)
2. Heartburn
3. Headache
4. Rhinitis
5. Diarrhea
6. Inflammation of the pancreas
7. Increased sweating
8. Hair loss (*alopecia*)
9. Pemphigus
10. Confusion
11. Hallucinations
12. Nervousness
13. Mania
14. Jaundice
15. Decreased libido
References

1. NCBI link 1
2. NCBI link 2
3. NCBI link 3
4. NCBI link 4
5. NCBI link 5