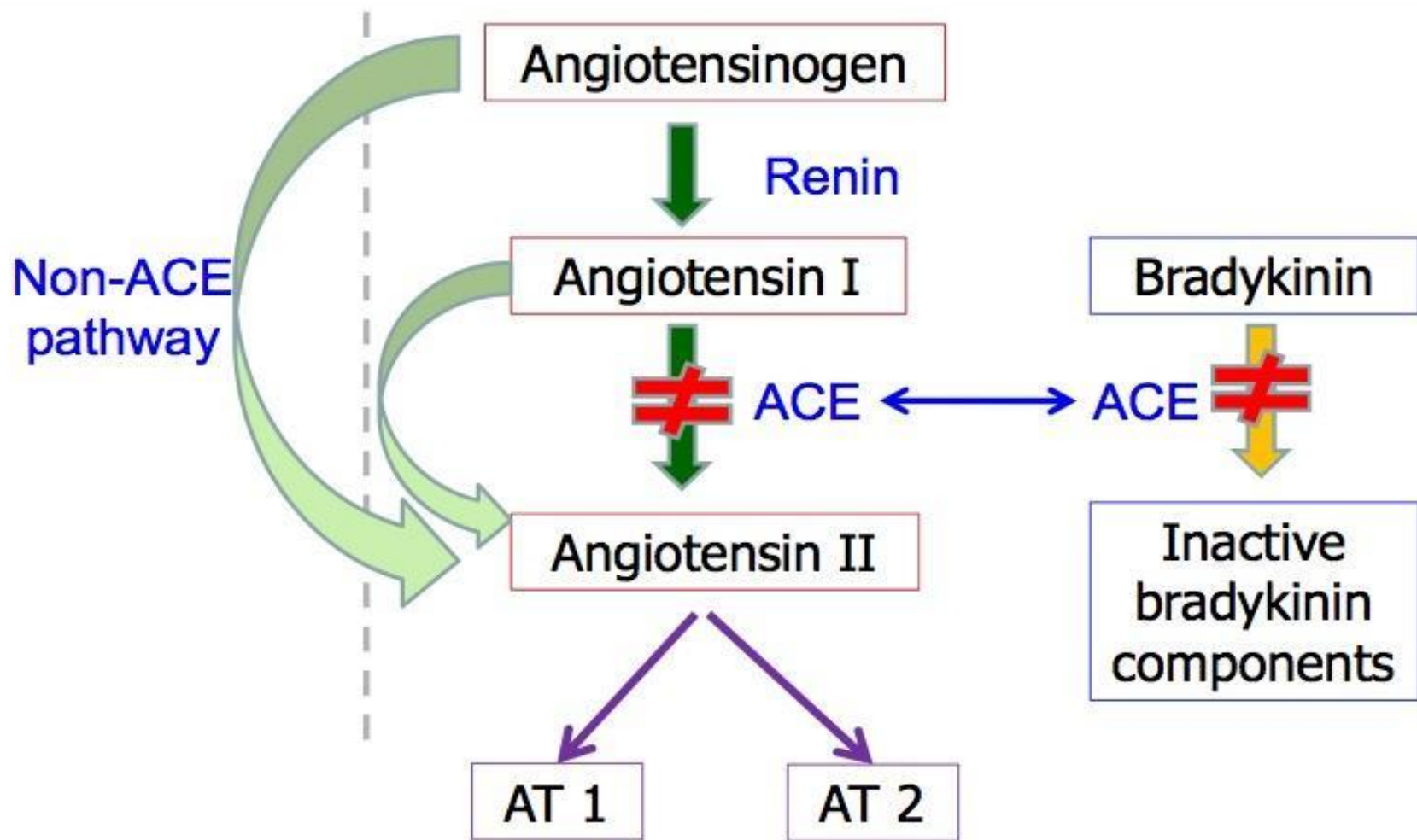


Angiotensin-Converting Enzyme Inhibitors toxicity

ACE inhibitor

An angiotensin-converting-enzyme inhibitor (ACE inhibitor) is a pharmaceutical drug used primarily for the treatment of hypertension (elevated blood pressure) and congestive heart failure.

This group of drugs cause relaxation of blood vessels, as well as a decreased blood volume, which leads to lower blood pressure and decreased oxygen demand from the heart. They inhibit the angiotensin-converting enzyme, an important component of the renin-angiotensin-aldosterone system.



≠ : Steps inhibited by ACE inhibitors

od)

Renin
(in kidney)



Decreased
angiotensin II

Decreased
aldosterone
production

↓ Output of
sympathetic
nervous system

↑ Vasodilation
of vascular
smooth muscle

↓ Retention of
sodium and
water

↑ Levels of
bradykinin



Decreased
blood
pressure

ACE inhibitors are easily identifiable by their common suffix, '-pril'. ACE inhibitors can be divided into three groups based on their molecular structure:

Sulfhydryl-containing agents

- [Captopril](#) (trade name Capoten), the first ACE inhibitor
- [Zofenopril](#)

Dicarboxylate-containing agents

This is the largest group, including:

- [Enalapril](#) (Vasotec/Renitec)
- [Ramipril](#) (Altace/Prilace/Ramace/Ramiwin/Triatec/Tritace)
- [Quinapril](#) (Accupril)
- [Perindopril](#) (Coversyl/Aceon/Perindo)
- [Lisinopril](#) (Litril/Lopril/Novatec/Prinivil/Zestril)
- [Benazepril](#) (Lotensin)
- [Imidapril](#) (Tanatril)
- [Trandolapril](#) (Mavik/Odrik/Gopten)
- [Cilazapril](#) (Inhibace)

Phosphonate-containing agents

- Fosinopril (Fositen/Monopril) is the only member of this group

Alacepril	Pivopril
Pentopril	Quinapril
Captopril	Ramipril
Cilazapril	Rentiapril
Delapril	Sampatrilat
Delapril	Ilepatril
Enalapril	Imidapril
Fosinopril	Spirapril
Idrapril	Temocapril
Moexipril	Libenzapril
Omapatrilat	Trandolapril
Benazepril	Zofenopril

Amlodipine plus benazepril
Amlodipine plus indapamide plus perindopril
Amlodipine plus ramipril
Atorvastatin plus ramipril
Benazepril plus hydrochlorothiazide
Benazepril plus spironolactone
Captopril plus hydrochlorothiazide
Cilazapril plus hydrochlorothiazide
Diltiazem plus enalapril maleate
Enalapril maleate plus felodipine

Enalapril maleate plus hydrochlorothiazide
Enalapril maleate plus nitrendipine
Enalapril plus hydrochlorothiazide
Felodipine plus ramipril
Fosinopril plus hydrochlorothiazide
Hydrochlorothiazide plus lisinopril
Hydrochlorothiazide plus moexipril
Hydrochlorothiazide plus quinapril
Hydrochlorothiazide plus ramipril
Indapamide plus perindopril
Trandolapril plus verapamil

ACE inhibitors were initially approved for the treatment of hypertension, and can be used alone or in combination with other antihypertensive medications. Later, they were found useful in other cardiovascular and kidney diseases including:

- Acute myocardial infarction (heart attack)
- Cardiac failure (left ventricular systolic dysfunction)
- Kidney complications of diabetes mellitus (diabetic nephropathy)

Adverse effects

Common adverse drug reactions include: **hypotension, cough, hyperkalemia, headache, dizziness, fatigue, nausea, and renal impairment.**

ACE inhibitors might increase inflammation-related pain, perhaps mediated by the buildup of bradykinin that accompanies ACE inhibition.

The main adverse effects of ACE inhibition can be **understood from their pharmacological action.** The other reported adverse effects are hepatotoxicity and effect on the fetus.

Overdose with ACE inhibitors may cause **hypotension, tachycardia, hyperkalaemia,** and **acute renal failure**. However, the majority of overdoses are asymptomatic and serious morbidity is exceptionally rare.

Activated charcoal, adequate fluids and a short period of observation are all that is generally required.

TREATMENT

Supportive

Patients should be given adequate fluids, if necessary with IV fluids, to maintain a satisfactory blood pressure and a good urine output. If patients are well after 6 hours, they should be medically fit for discharge.

GI Decontamination

Oral [activated charcoal](#) may be given to patients who have ingested a large overdose if they present within 1-2 hours. Generous fluid replacement to counteract the volume depletion associated with [gastrointestinal decontamination](#) is particularly important in overdose with drugs that lead to hypotension via vasodilatation.

Antidotes

Angiotensin II, while a logical antidote for ACE inhibitor overdose, is not generally available and should not be required. Naloxone has been used with some effect in captopril poisoning but is not recommended for routine use.