The significance of coronary flow reserve in chest pain syndromes

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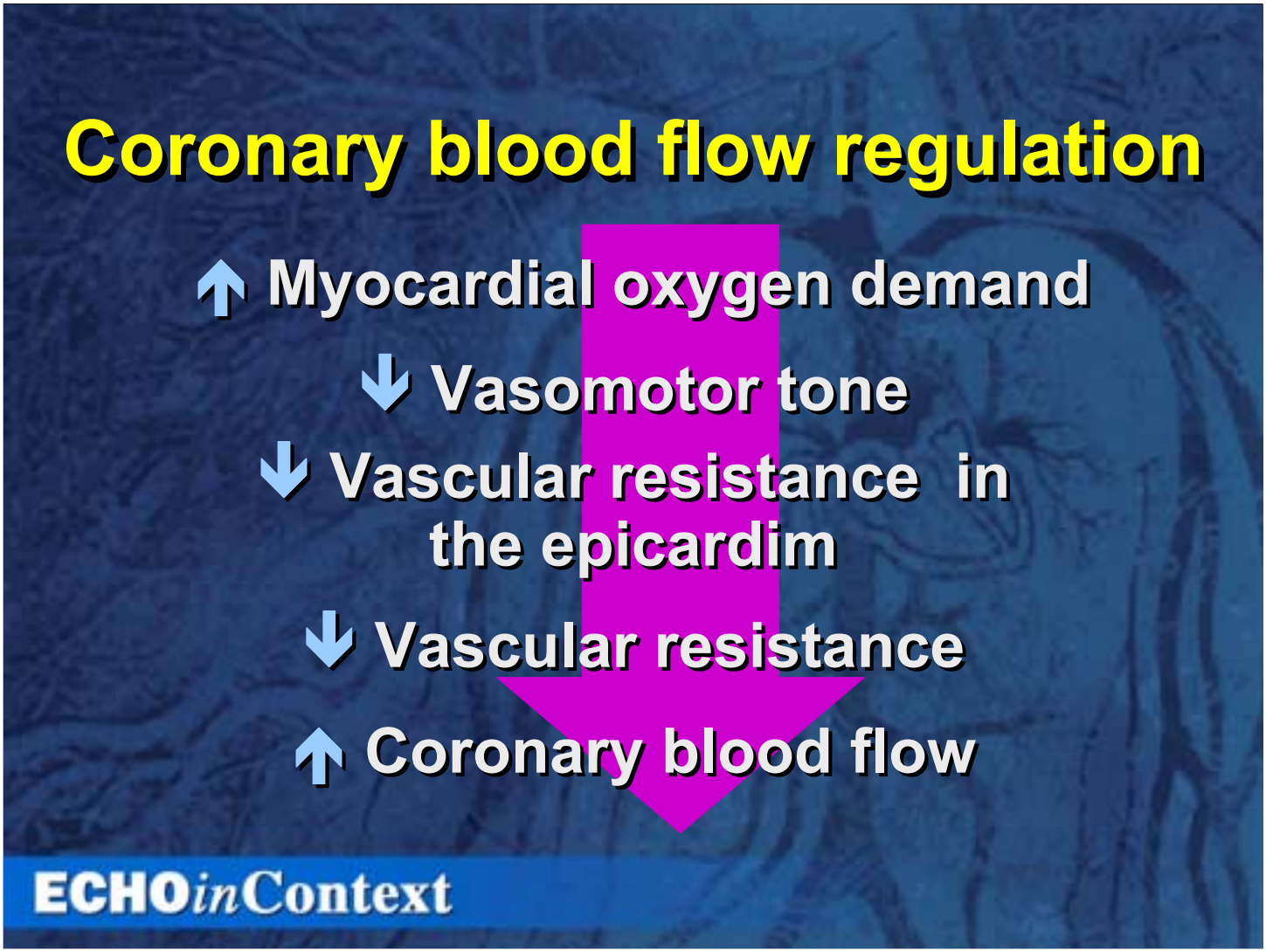
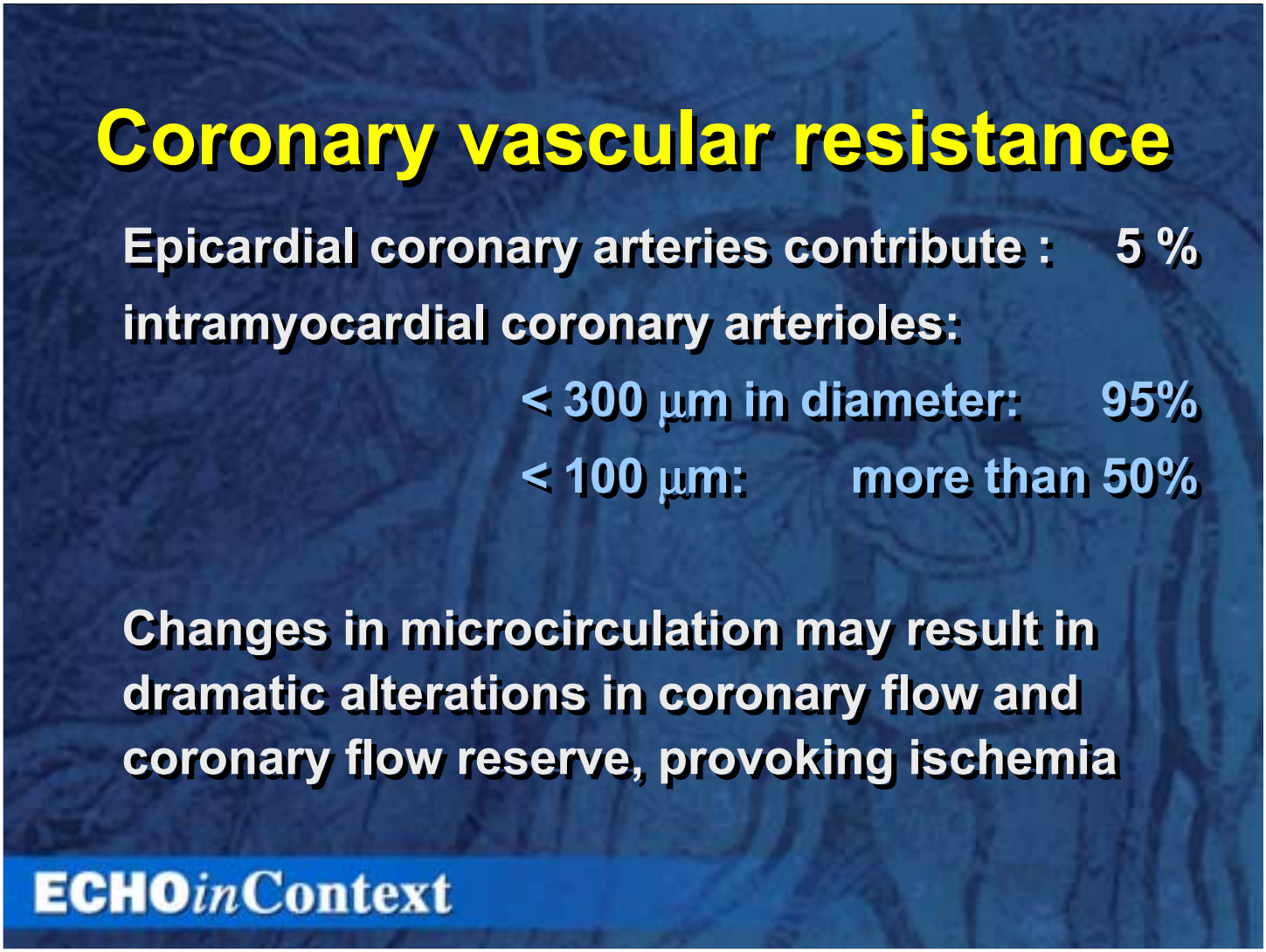
ECHO*in*Context



The increase in coronary blood flow occuring with augmented myocardial oxygen demands is regulated by changes in the vascular resistance of the coronary arteries.

The ability to increase coronary blood flow in response to vasoactive mechanisms is coronary flow reserve.



The major epicardial coronary arteries contribute only about 5% to the total vascular resistance. The intramyocadial coronary arterioles are responsible for the majority of coronary resistance

Major mechanisms of coronary flow regulation

Endothelial: arterioles 80-150 μm diam/epicardial arteries

vasoactive substances like nitric oxide, prostaglandins, endothelium-derived hyperpolarizing factor (EDHF), endothelin

Metabolic: arterioles 25-100 μm diam

adenosine, major metabolite that mediates metabolically induced coronary vasodilation during myocardial ischemia

Myogenic: arterioles 50-100 μm diam

intrinsic property of vascular muscle: vascular smooth muscle contraction or relaxation: vasodilation due to potassium ion efflux via ATP sensitive potassium channels – it is important, since myogenic constriction and dilation occur during autoregulation

Neurohumoral: arterioles, epicardial arteries 140-300 μm arteries

vasoactive substances like nitric oxide, prostaglandins, endothelium-derived hyperpolarizing factor (EDHF), endothelin

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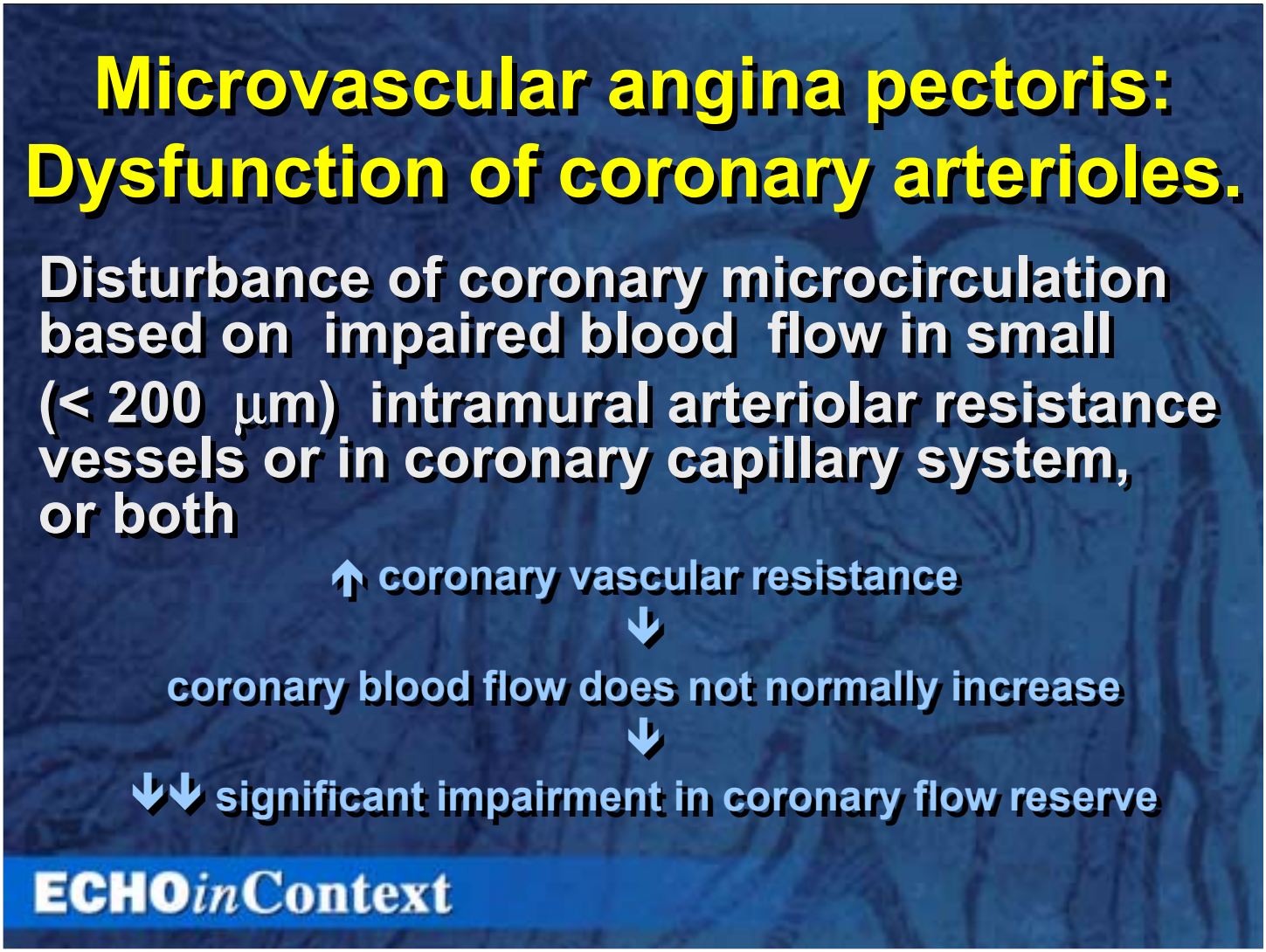

The term „microvascular angina pectoris" was proposed by Cannon and Epstein in 1985 for the symptoms „angina pectoris + positive ergometry test + epicardial coronary arteries without stenosis"

Functional causes of disturbances in coronary microcirculation

Vascular	hypertensive microangiopathy diabetic microangiopathy systemic collagen diseases, immune vasculitis posttransplantation vasculopathy
Metabolic	diabetic endothel dysfunction hyperlipoproteinemia disturbance of oxygen diffusion and transport
Rheologic	paraproteinemia polyglobulia, polycythemia hyperlipoproteinemia

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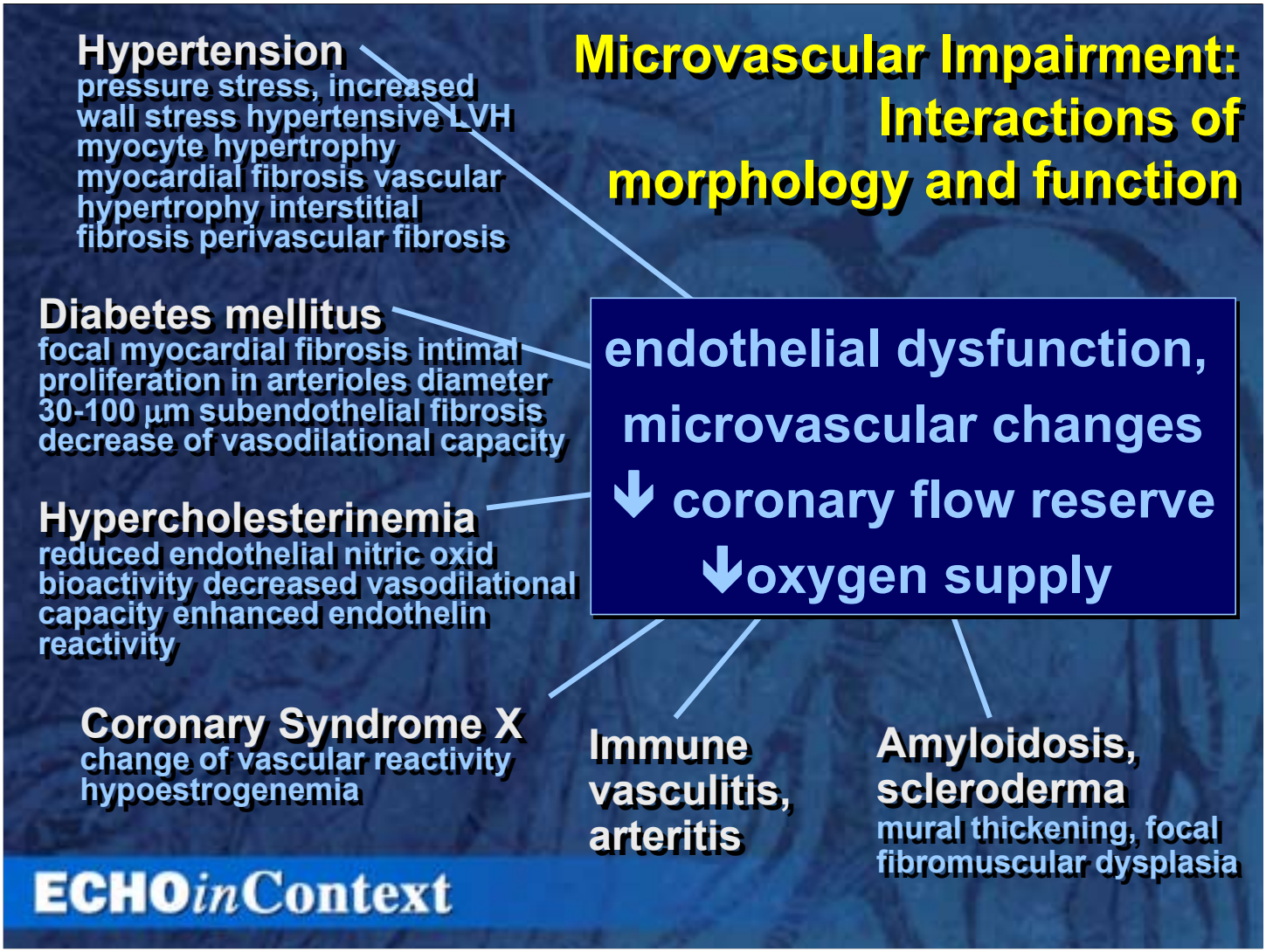
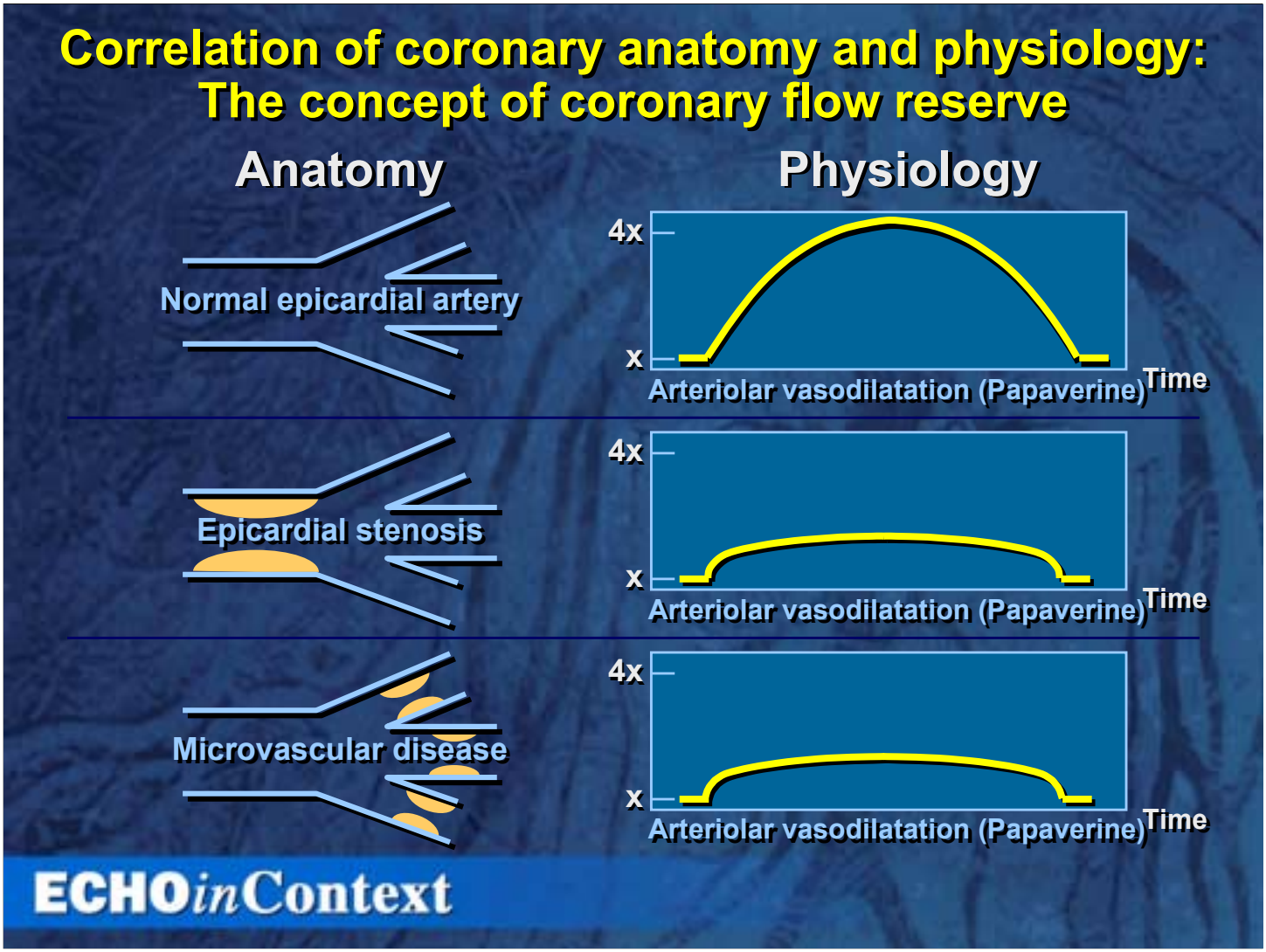
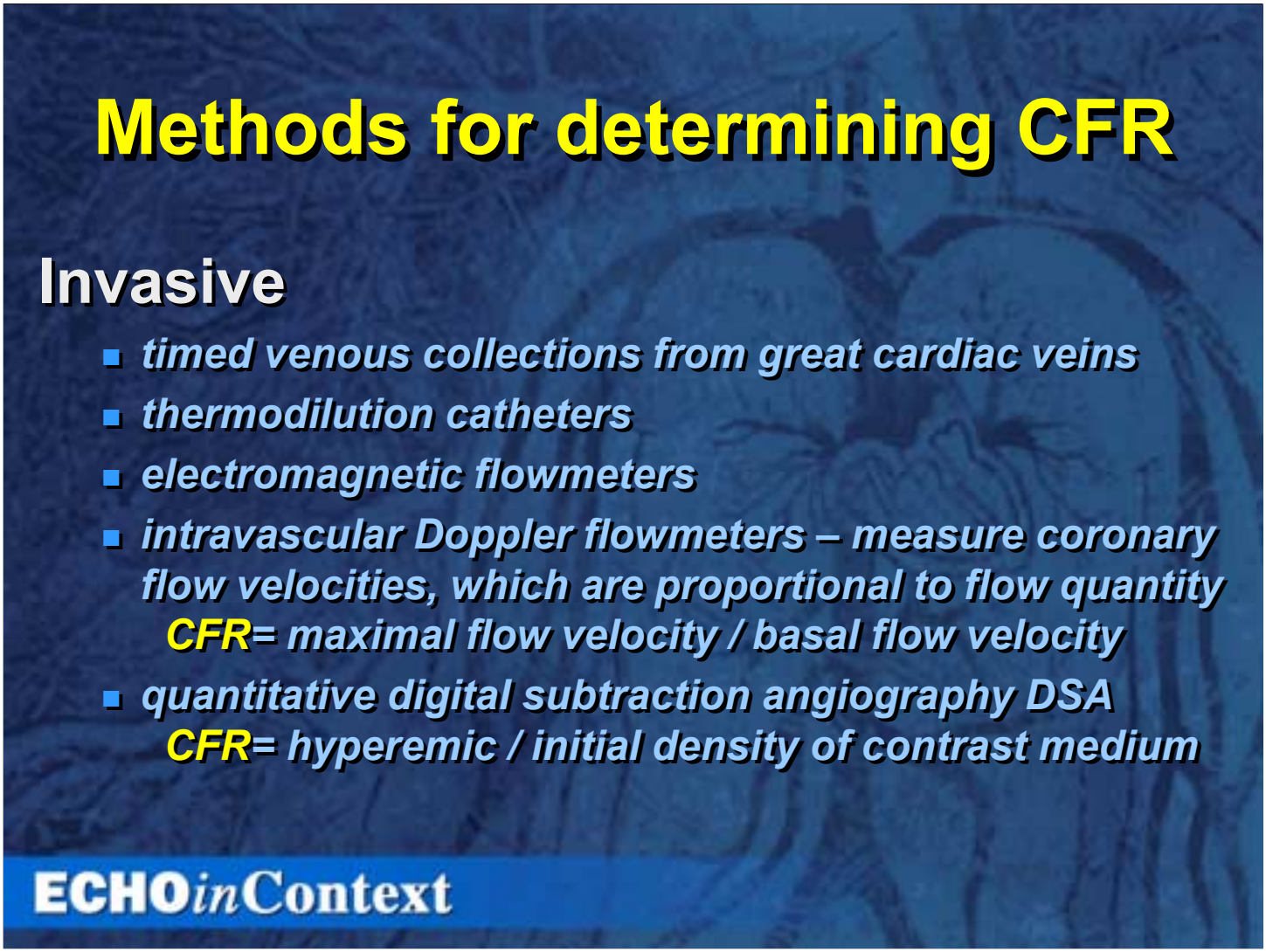


Microvascular impairment – interactions of morphological and functional changes

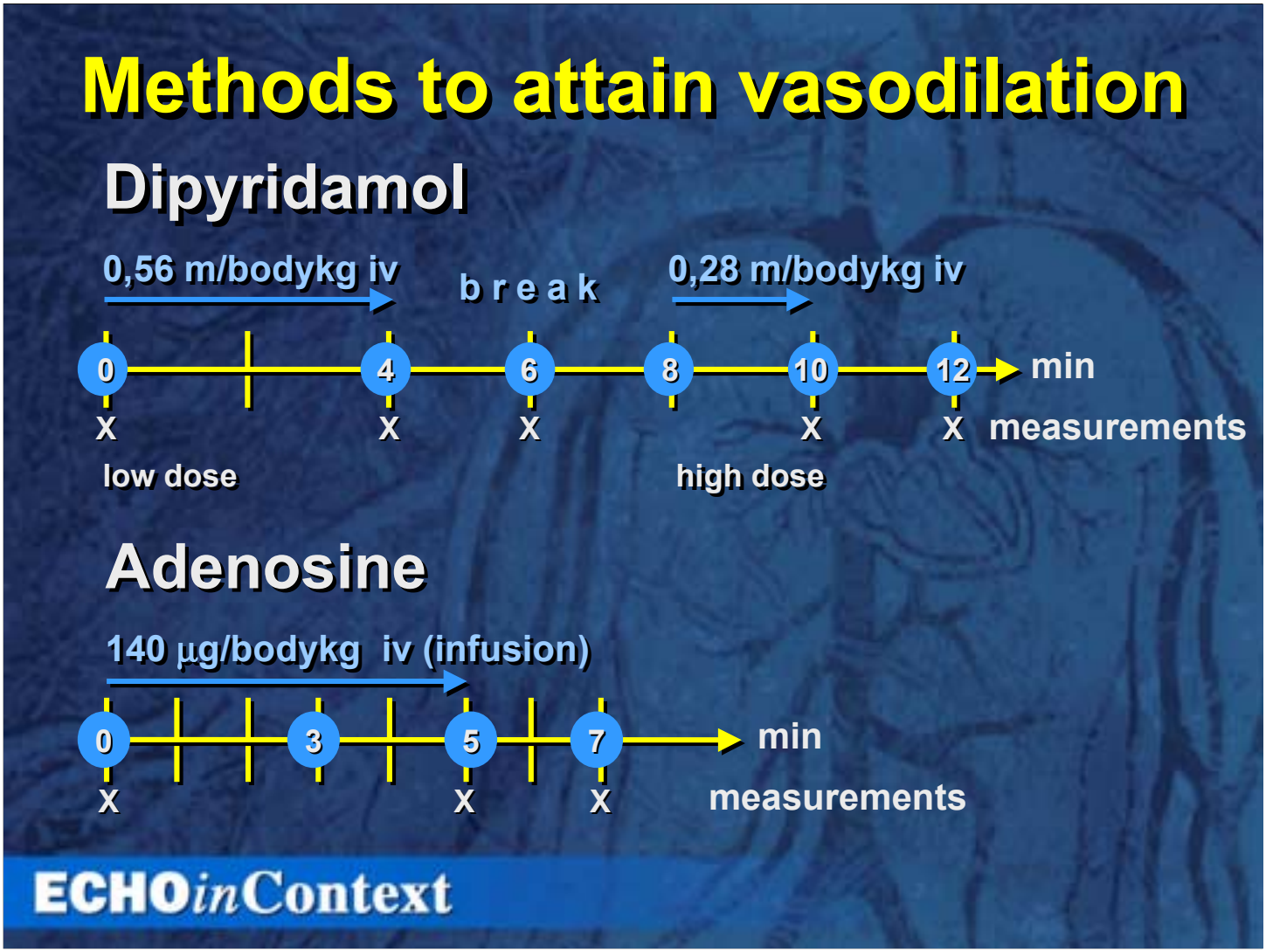
microvascular impairment is prominent in patients with angina pectoris, manifested in systemic hypertension, in diabetic patients, in cases of other metabolic and rheologic disorders as a result of endothelial dysfunction, vascular remodelling, changes in vascular reactivity and cardiac muscle hypertrophy.

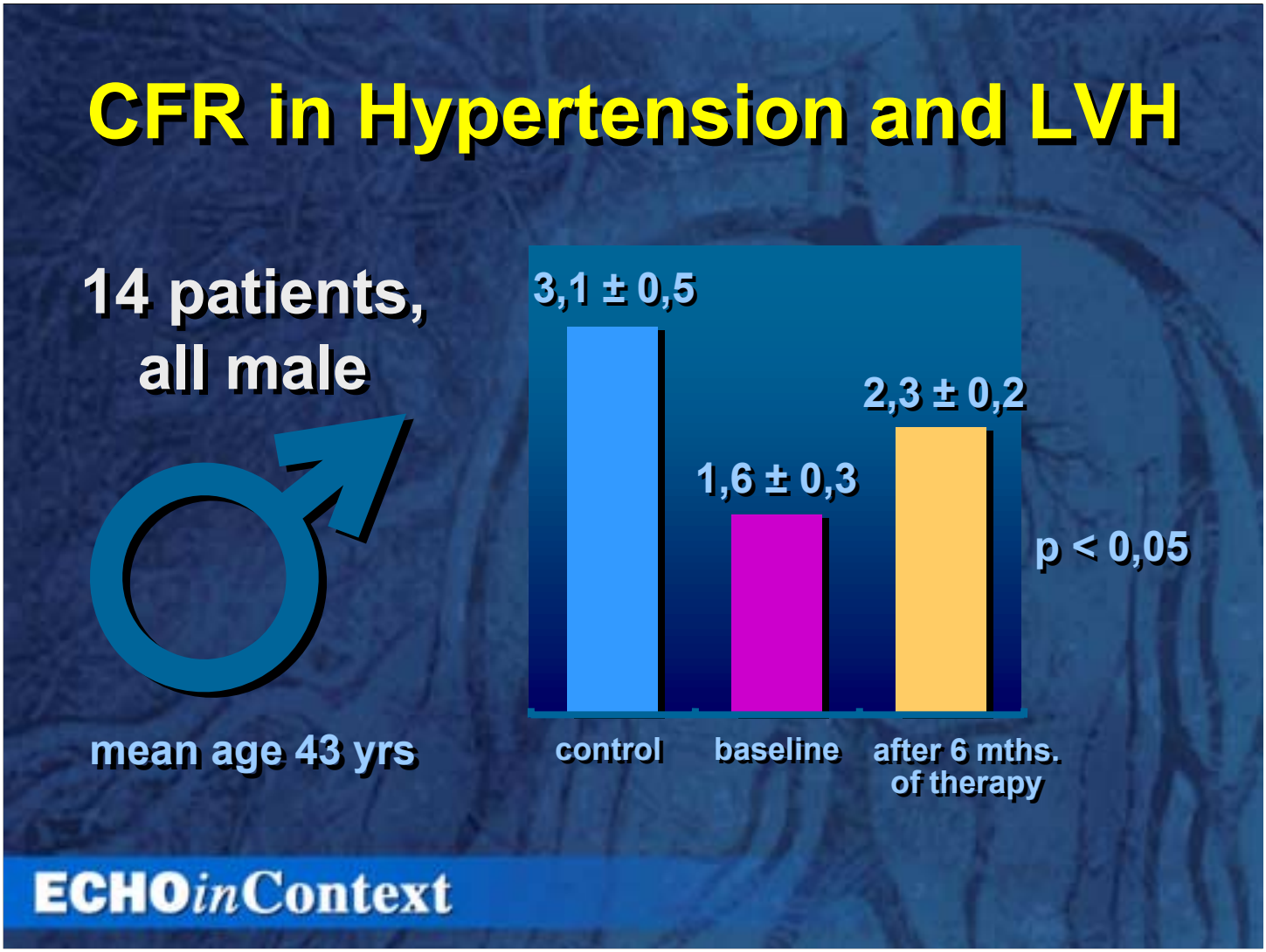


In the presence of normal epicardial arteries and normal microvasculature, the CFR is normal. Severe flow limiting epicardial stenosis or microvascular pathologic state of the coronary arterioles result the diminution of the CFR.

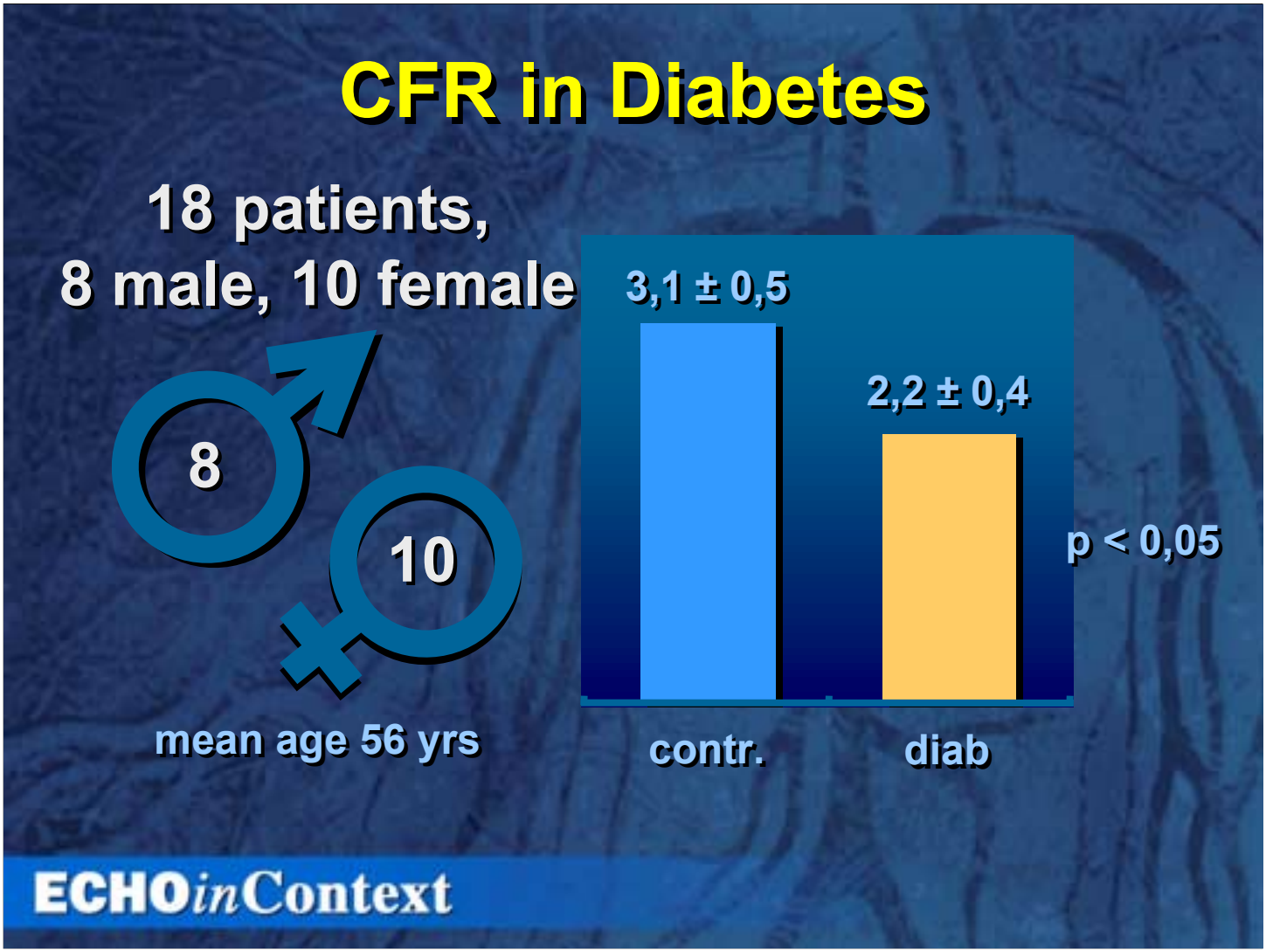


A normal coronary flow reserve is approximately four to five. With methods measuring not absolute coronary blood flow, but relative changes in perfusion or flow velocities the values are lower. The CFR is influenced by age, heart rate, preload, use of vasoactive pharmacological agents.

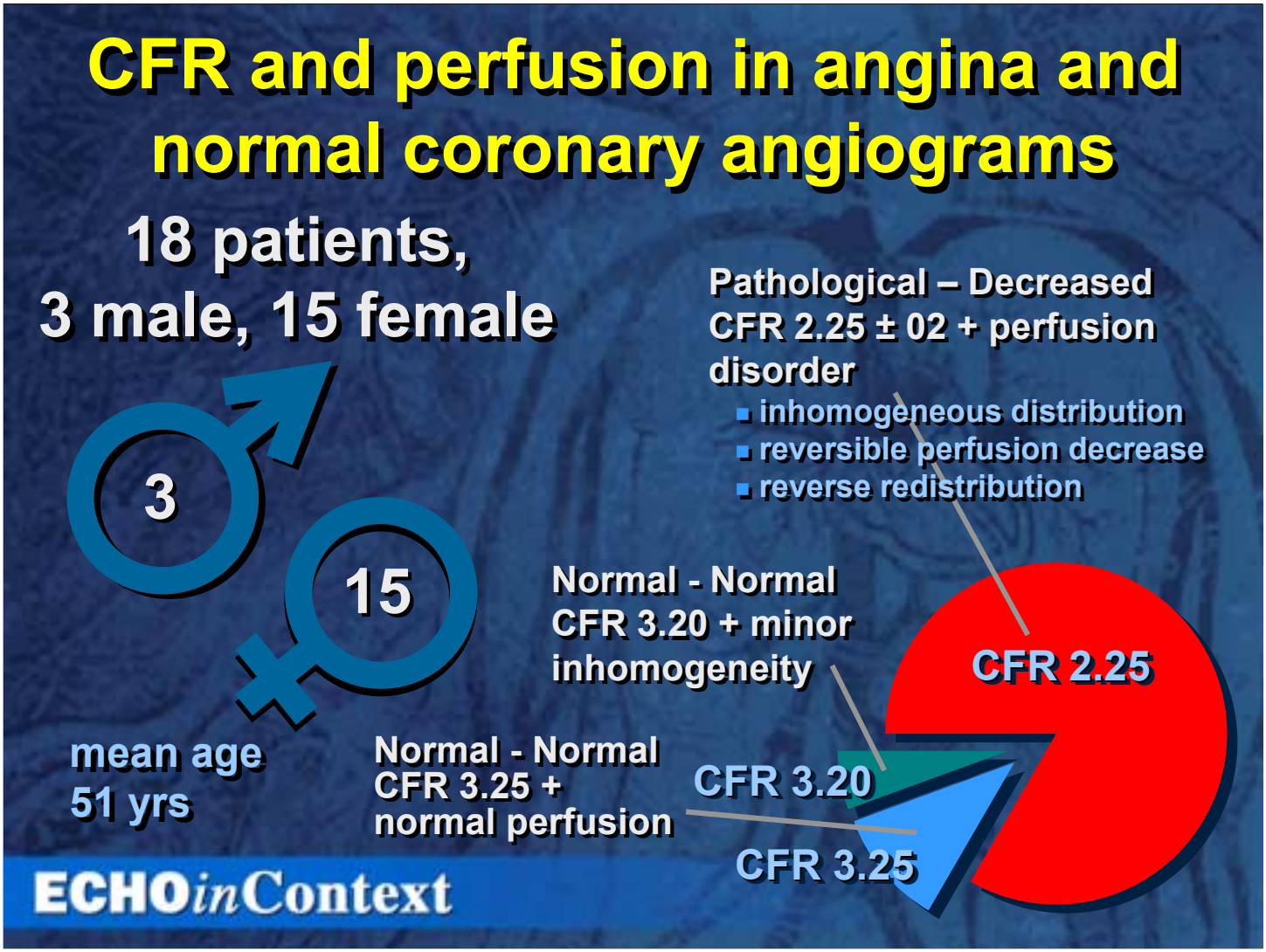




In a group of patients with systemic hypertension and left ventricular hypertrophy (pts with valvular disaese or known CHD and diabets mellitus were excluded) the CFR was reduced. 6 months after effective antihypertensive therapy with ACE-inhibitor or Ca-antagonist the repeated CFR increased significantly, although it did not reach the normal vale.



A group consisting 18 pts with diabetes mellitus was examined (exclusion criteria were hypertension, left ventricular hypertrophy, evidence of valvular or coronary heart diseases) with the method of TEE using Dipyridamole. The measurements confirmed significantly reduced CFR.



In 18 pts coronary angiography showed no substantial alterations despite chest pains and positive ergometry test. The perfusion was also determined through stress myocardial scintigraphy SPECT examination. In 15 of 18 pts the CFR had reduced distinctly (2,25), perfusion disorders in all of these pts have been observed, especially inhomogeneity of perfusion and reverse redistribution.