Arterial Stiffness Index "CAVI"

CAVI (Cardio-Ankle Vascular Index)

CAVI is an index reflecting the stiffness of the artery from the heart to ankles. As arteriosclerosis progresses, the CAVI value becomes higher. It is known that lowered extensibility of the aorta causes onset of heart disease and is a factor determining the prognosis. Thus, CAVI is useful for earlier diagnosis and care. CAVI is calculated based on the stiffness parameter β which is measured by carotid echography or the like and is not affected by blood pressure. Thus, it represents the natural vascular stiffness.

Clinical Usefulness

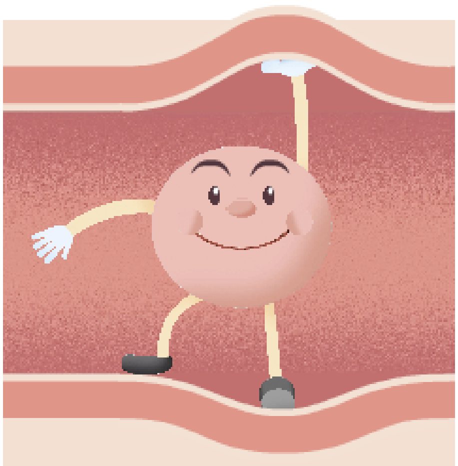
- Helps motivate treatment and correction of lifestyle.
- Enables quantitative judgment of the effects of risk factors to arteriosclerosis.
- Enables clear evaluation of medication effects.

Judgement Criteria

Reference value of CAVI

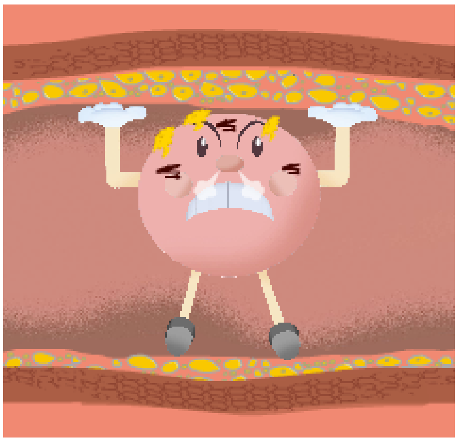
CAVI<8.0	Normal range
8.0≦CAVI<9.0	Borderline
9.0≦CAVI	Arteriosclerosis suspected

Low CAVI



Soft and flexible artery is considerably inflated by increased blood pressure

High CAVI



Arteriosclerotic artery is less inflated by increased blood pressure

Principle of CAVI

CAVI is calculated based on the stiffness parameter β which is measured by carotid echography or the

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like and represents the natural vascular stiffness independent of blood pressure.

1) What's the stiffness parameter β?

The stiffness parameter β is expressed with the following equation:

$$\beta = 【InPs/Pd】 \cdot 【D/\Delta D】 \quad \cdots (1)$$

Ps : Systolic pressure   D : Diameter
Pd : Diastolic pressure   ΔD : Change of Diameter

It is an index to diagnose sclerotic degrees of the carotid artery, etc. from the diametrical variation and blood pressure measured by ultrasonic echography. Under the stable physiological condition, there is an exponential relation between intravascular pressure and diameter (see Fig. 2). Substitute the natural logarithm of systolic-diastolic pressure ratio (InPs/Pd) and the arterial wall extensibility (ΔD/D) for intravascular pressure and diameter. Then, the relation will be linear as shown in Fig. 2. This straight slope is β. The higher the value, the lower the extensibility, that is, the stiffer the artery.

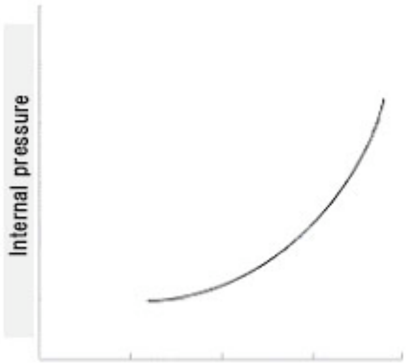

Fig. 1.Intravascular pressure and diametrical variation

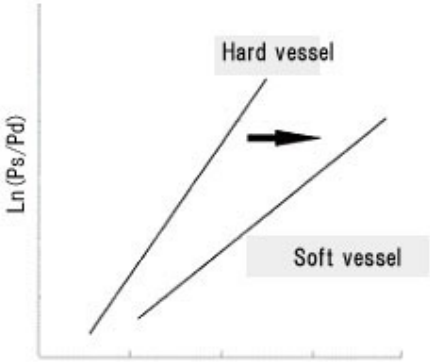

Fig. 2.Natural logarithm of systolic-diastolic pressure ratio and extensibility of arterial wall

2) Principle of CAVI

See equation (3) below. CAVI is calculated using the stiffness parameter β obtained with the Bramwell-Hill equation.

The stiffness parameter β

$$\beta = 【InPs/Pd】 \cdot 【D/\Delta D】 \quad \cdots (1)$$

Ps : Systolic pressure   D : Diameter
Pd : Diastolic pressure   ΔD : Change of Diameter

From the Bramwell-Hill equation

(Here, ratio of volumetrio change, V/ΔV, is converted to ratio of luminal change, D/ΔD.)

$$PWV^2 = \frac{\Delta P}{2\rho} \cdot \frac{D}{\Delta D} \quad \cdots (2)$$

$$\frac{D}{\Delta D} = \frac{2\rho}{\Delta P} \cdot PWV^2 \quad \cdots (2)'$$

Cavi is obtained by substituting equation (2)' for D/ΔD in equation (1).

The equation of CAVI

$$CAVI = \text{【} \ln Ps/Pd \text{】} \cdot \frac{2\rho}{\Delta P} \cdot PWV^2 \quad \cdots (3)$$

Ps : Systolic pressure　　Pd : Diastolic pressure

PWV : Pulase wave velocity between heart and ankle

ρ : Blood density　　ΔP : Pulse pressure

return　TOP

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