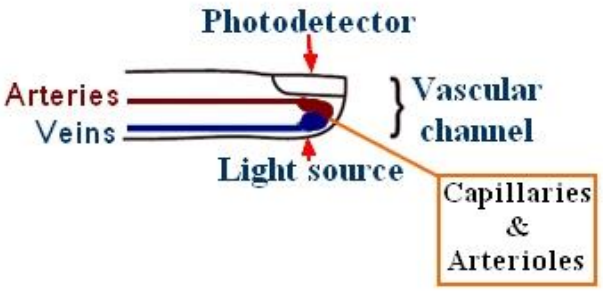
APG as a reflection of vascular status

Principles of the APG technique

APG has been described as a non-invasive technique to measure vascular stiffness and aging (see also the APG technique section). Due to the process of arteriosclerosis, vessel stiffness increases with age, resulting in changes in the peripheral pulse wave. These changes can be measured using the APG technique.



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APG and aging & vascular stiffness

Several studies show that parameters of the APG wave signals can be used to determine characteristics of vascular aging. The pattern of 5 waves (a,b,c,d,e) changes with increasing age and increasing vessel stiffness (figure 1, from[1]). Especially the b and d waves and their correlation to the a-wave are related to vessel stiffness.

Ratios of the five waves have been described to change with increasing vessel stiffness. The d/a ratio was found to be positively correlated with age, while the b/a, c/a and e/a ratio are negatively associated with aging[2]. An aging index ((b-c-d-e)/a) was developed to determine the vascular age using the APG signal[2,3].

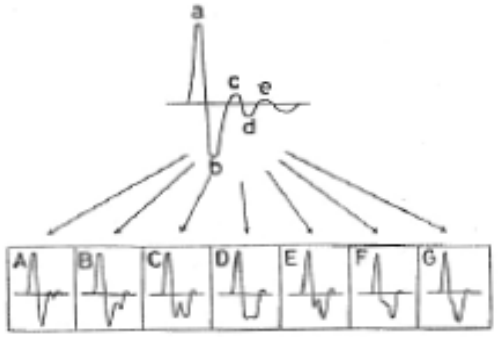
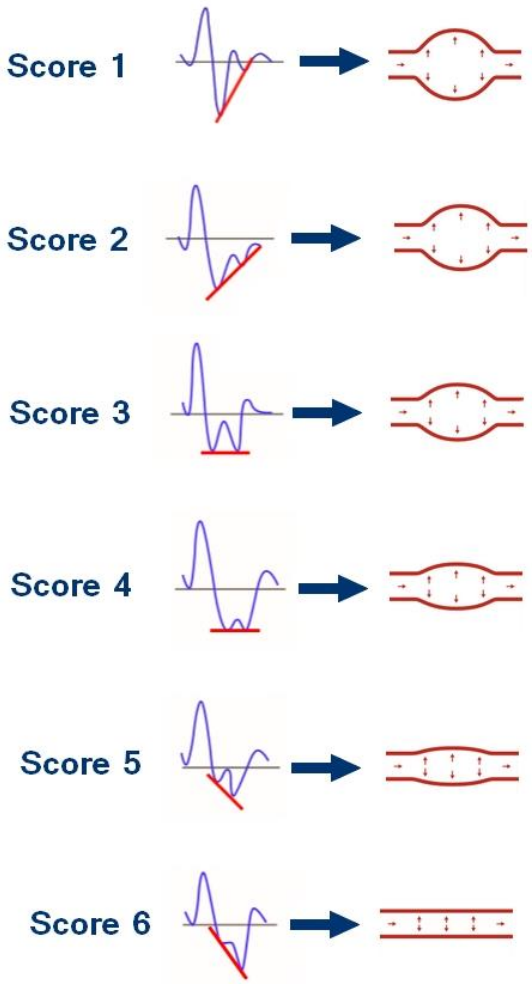


Figure 1: Typical APG waveform and changing waveform patterns with aging[1]

APG and cardiovascular diseases

APG ratios have also been found to be correlated with vessel distensibility[4], atherosclerotic changes in the carotid artery[4,5], blood pressure[3] and gender[3]. A link was found between the APG signal and the Framingham risk score[6] and other risk factors of cardiovascular disease such as dyslipidemia, smoking and lack of regular exercise[7]. Specific changes in the APG signal were seen in hypertensive patients with left ventricular hypertrophy[8].



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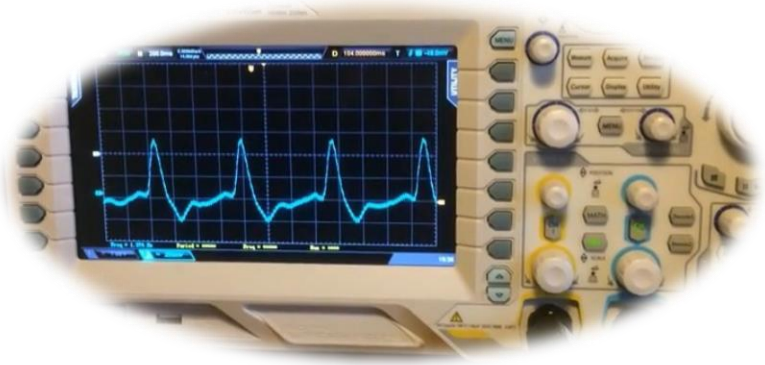
APG: other applications

Next to measuring vascular status, APG can also be used for characterizing the response of the vessels to vasoactive agents[2,9] and to characterize heart-rate-variability[10,11].



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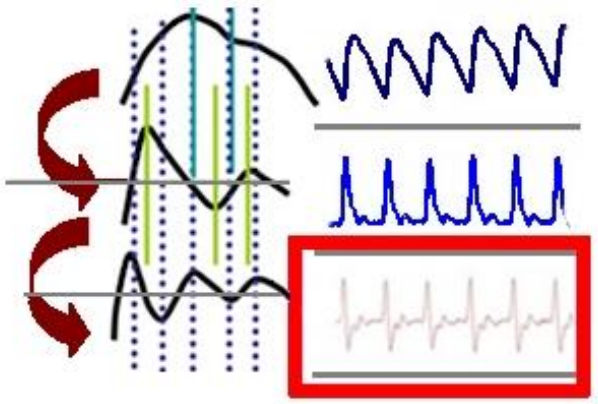
APG versus Pulse Wave Velocity (PWV)

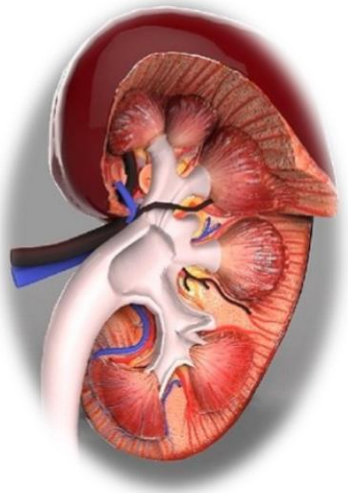
Accelerated plethysmography is a relatively new technique in the cardiovascular field. The gold standard for measuring arterial stiffness is Pulse Wave Velocity, a technique that is also dependent on the pulse wave travelling through the vessels. The b/a and d/a ratios and the aging index of APG were found to be correlated to PWV[12]. Another study showed that in an hypertensive population, both PWV and APG could indicate vascular stiffness and aging[13].



APG versus Pulse Wave Velocity (PWV)

Both PWV and indices of the APG signal were also strongly correlated with age in a normotensive population[14]. In chronic kidney disease patients, APG correlated well with aortic calcification index as a measure of arteriosclerosis[15].

The original PPG signal has been shown to have comparable wave contours as the peripheral pulse pressure measured by tonometry in both normotensives and hypertensives[16].



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APG: conclusion

The APG signal measured at the finger reflects the overall vascular status of the person measured and can give valuable information about the possible existence of cardiovascular diseases which warrant further investigation by a medical doctor. APG has been shown to correlate well with the gold standard and is increasingly being used in the cardiovascular fields to easily and non-invasively measure vascular status.

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For more in-depth discussion, please refer to the scientific publications.

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