Rev. 03

July 2021

MyLab

ADVANCED OPERATIONS

QAS SECTION

350033800

Table of Contents

Chapter 1

1 - QAS Option and its activation

This chapter explains how to activate and use the QAS (Quality Arterial Stiffness) calculation.

The QAS option requires a specific licence to be installed on the **MyLab**.

NOTE ***The QAS licence requires the Vascular licence.***

General Information

QAS is the real-time measurement of the change in diameter (or Distension) of the blood vessel walls caused by a traveling Blood Pressure Wave originated by heart pumping.

Distension in combination with Brachial Pressure (Psys/Pdia) can be used to asses the Arterial Stiffness parameters and characteristics time point on the Local Pressure Waveform.

In the clinical literature, Arterial Stiffness is emerging as the most important parameter to evaluate Cardio-Vascular complications and events.

WARNING **The QAS algorithm works correctly on normal patients thanks to the automatic detection in real time. However, there might be cases where the algorithm could be unable to track the vessel wall. In all these situations, it is recommended to check the results of the automatic tracking and to discard them, if they are not satisfactory.**

Probes

The following probes can be used in QAS:

- L 3-11
- L 4-15
- SL1543
- SL2325

Activating the QAS Calculation

The automatic QAS calculation can be activated from the vascular application when one of the proper probes is active.

Procedure

1. Enter the patient's data, and in particular specify the Systolic and Diastolic Brachial Pressure.
2. Select the vascular application and, if necessary, the probe.
3. Press **START EXAM** to enter real time mode.
4. Optimize the B-Mode image.

NOTE ***The image has to be optimized in fundamental (FUNDAMENT) before activating QAS. The optimization should be repeated if it is activated in TEI (TEI mode is not available in QAS).***

5. Tap **TOOLS** and select the QAS icon.

NOTE ***The QAS calculation cannot be activated when one of the following modes is active: 3D/4D, CnTI or VPan.***

While in QAS, the system keys and controls are available (**B–MODE** tab).

NOTE ***Some controls (for instance multi focus or MView) are not available in QAS: the corresponding buttons are displayed in gray.***

Screen Layout

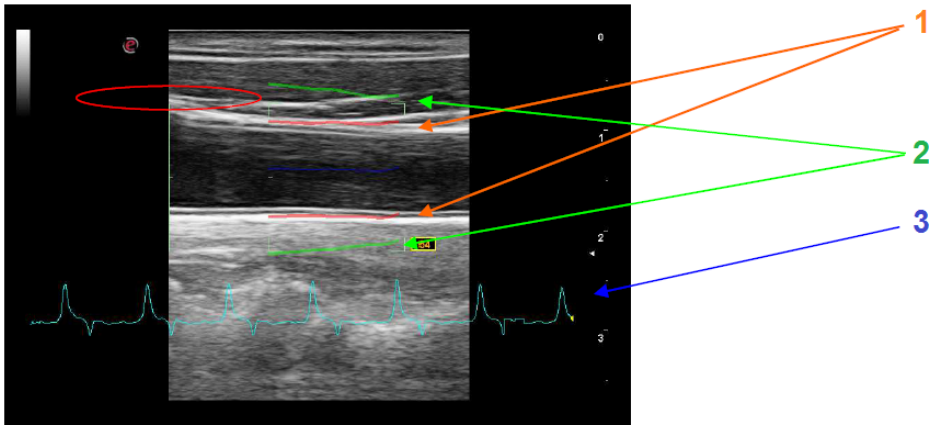
Once the automatic QAS calculation is activated, the wall tracking functionalities starts.

WARNING **Automatic measurement results are intended as a suggestion and should not be considered sufficient to make a diagnosis.**

The QAS computation is performed inside the portion of B-Mode image indicated by the Region of Interest (ROI). The ROI size and position can be changed with the trackball. At each ROI movement the QAS acquisition restarts. ACTION allows the ROI dimensions to be changed.

The graphic references are superimposed on the standard B-Mode image, as shown in the picture below.

Fig. 1-1: QAS references



Where:

1. The orange lines represent the vessel wall average diameter tracking.
2. The green lines are associated to the wall distension. The real distensibility represented by the green lines movement is "amplified" giving a fast estimation of the vessel elastic properties and furthermore helping for a good detection (green lines should be as continuous as possible).
3. The distension curve or the velocity curve over time can be shown in blue below the ultrasound image when the **TRACK SEL** key is set to **DIST TRACK** or **VEL TRACK** respectively.

At the bottom-right is displayed the Standard Deviation indicator: a yellow rectangle will blink at each cardiac cycle detected. The SD value is Green when SD value is <=35, Orange otherwise. The blinker is activated each time QAS values are updated in measure area.

Chapter 2

QAS

2 - QAS Acquisition

This chapter explains how to perform a QAS exam and which controls are available during the acquisition.

Image Acquisition

For a correct QAS acquisition, the line middle indicator must be positioned at the center of the vessel. The arterial wall segments should be assessed in the longitudinal way, strictly perpendicular to the ultrasound beam, with both walls clearly visualized. The yellow reference line (to the left) must be positioned on the bifurcation when measuring.

The Lumen Indicator represents the point where the automatic vessel border detection begins. It has to be positioned in the middle of the Lumen. The reference on the line must be positioned at the center of the vessel. The reference line has to be positioned on the carotid bifurcation when measuring it.

The Reference Line helps the user to position the ROI always at the same distance respect to the reference anatomical point (in particular the Bulb). The default position is 10mm respect to the ROI. This value can be preset. The distance can be changed by acting on the proper encoder on the Touchscreen.

NOTE ***Make sure the artery is clearly visible and horizontally in the image. Adjust the size of the ROI box according to the artery size.***

The ROI is correctly placed when there is:

- A continuous and stable horizontal orange line, which represents the arterial diastolic diameter.
- A continuous green line on the far wall of the carotid artery, representing the arterial distension.
- The reference line must be positioned on the bulb origin

NOTE ***The QAS measurements should be performed on the far wall in the Common Carotid Artery, with the bifurcation on the left side at least 10mm far from the origin of the bulb.***

Use the controls available to optimize the image within the ROI.

NOTE ***Adjust the controls so that the structure under examination is well defined.***

Adjust the image in order to increase the density of the lines: high density means high quality in measuring the intima-media thickness. When the lines are stable and optimal, it is recommended to minimize the standard deviation.

Controls in QAS

In QAS the **B–MODE** tab displays the touchscreen with available system keys and controls for the image optimization.

The **QAS** tab of the touchscreen displays the following controls:

FREQUENCY affects the imaging frequency (PEN for optimal penetration, RES for optimal resolution, GEN for the best balance between resolution and penetration).

REF LINE sets the distance between the vertical line and the ROI.

DEPTH increases or decreases the scanning depth.

AVERAGES ONLY When it is activated, only the average values (AVG and SD) are shown in the measure area.

TRACK SEL allows to select the visualization of Distension or Velocity Waveform.

ZOOM enlarges the 2D area; the enlargement factor can be modified.

To Enlarge the 2D Area

- If necessary, press the button to activate the ZOOM control: the image will be contoured by a yellow frame.
- Act on the toggle to change the zoom factor.
- Use the trackball to pan the image.

Press the **ZOOM** button to activate the full 2D format.

PHYSIO activates the menu to change the trace position, when available, and to adjust its gain and amplitude.

Procedure

1. Tap **PHYSIO** to display the menu.
2. **ECG** enables or disables the ECG trace display on the screen.

The ECG signal is displayed on the ultrasound image if visualization is set to ON, together with the Distension Waveform. If ECG is connected and active it is used as input for cardiac cycle detection. If ECG is not connected or inactive the cardiac cycle will be automatically detected by the software.

- Use **HEIGHT** to change the height of the area to display the ECG trace.
- Modify the amplitude of the signal using **GAIN**.
- If necessary, **POSITION** moves the trace on the screen.
- Press **BACK ARROW** to return to the real time menu.

QAS in Freeze

The **QAS** tab of the touchscreen displays the following controls available in freeze

SEND TO REP LEFT/ RIGHT adds the frozen measurements and the distension curve into the examination report. If several measurements are sent to the report, the latest one overwrites the previous one.

Exit QAS

In order to exit from the QAS calculation, either tap **EXIT QAS** or **TOOLS** and then select the QAS icon.

Chapter 3

QAS

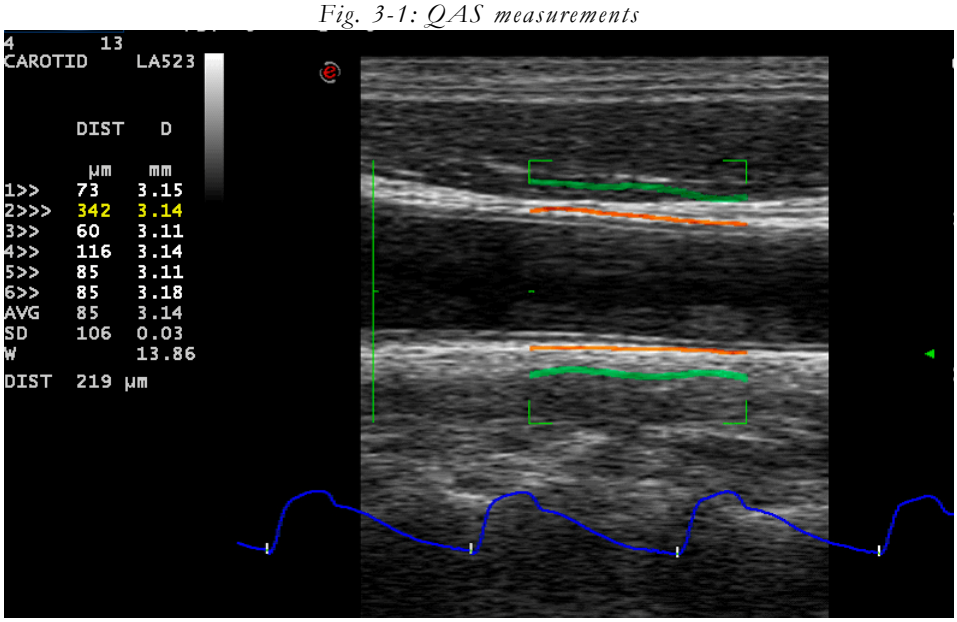
3 - QAS Automatic Measurements

This chapter describes which measurements are automatically calculated.

Measurements

The QAS calculation automatically measures the modification of the arterial diameter between the Systolic and Diastolic phases. The vessel stiffness is calculated starting from this value and from the Brachial Pressure Values.

Fig. 3-1: QAS measurements



The system cyclically computes six (6) successive measurements of both the Arterial Distension and Diameter.

The system shows on the left of the image the table with the results of the automatic measures. The first column (DIST) indicates the Distension in micrometers, the second (DIAM) the Arterial Diameter in millimeters. The rows of the table contain the six (6) successive measurements, continuously updated, their average (AVG) and standard deviation (SD).

When the ECG is connected and active also ECG Track and Heart Rate (HR) value are displayed.

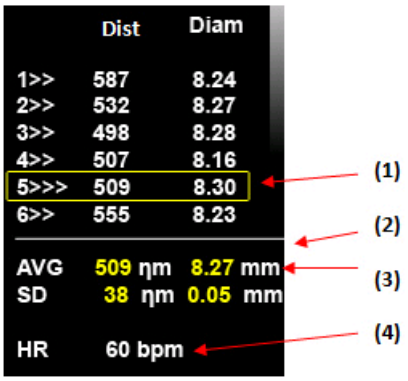
The values related to the last computed cardiac cycles are highlighted in yellow.

NOTE ***In Live mode the output values are related to the last complete cardiac cycle.***

It is possible to select the visualization of the averages only by **AVERAGES ONLY**.

The vessel distension and diameter are measured several times on each cardiac cycle. The average is calculated for each cardiac cycle.

Fig. 3-2: QAS Measurements Area



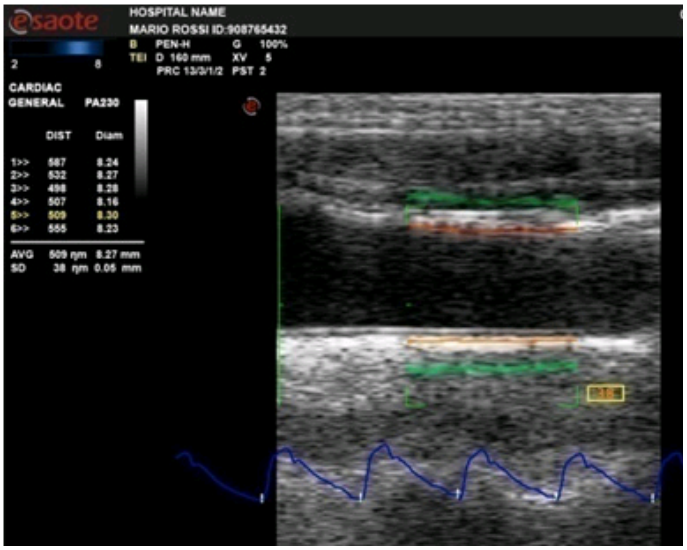
Standard Deviation (SD) of the Distension should be below 20 micrometers

Standard Deviation (SD) of the Diameter should be below 0.2 millimeters

Waveforms

During the acquisition, the instantaneous Distension or Velocity Values are plotted to generate a Distension or Velocity Waveform versus Time depending to the selection done with **TRACK SEL**.

Fig. 3-3: Distension Track Layout



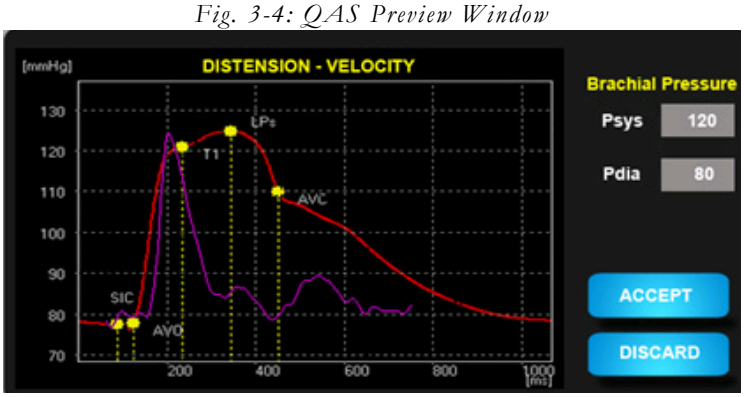
When in Freeze, by using the trackball a marker can be moved on the Waveform to evaluate some of the characteristic points.

In Freeze, pressing MAGE saves the screenshot with the related measurements.

When **SEND TO REP LEFT/RIGHT** is pressed, a preview window including Brachial Pressure Data and both Distension (in red) and Velocity (in purple) Waveforms is displayed.

If the waveform is not good for a correct QAS measure, the following message is displayed: "The waveform shape does not allow the QAS calculations". Press **OK** to repeat the measure.

Fig. 3-4: QAS Preview Window



The Waveforms are represented in micrometers in the Vertical Scale and characteristics points are displayed.

As default, as Brachial Pressure values are displayed the values from the Patient ID windows (if present), anyway Psys, Pdia values can be edited using values measured during the acquisition (by using an external device).

If the waveform is satisfying in term of continuity it can be sent to the report pressing **ACCEPT**, otherwise, if the waveform is not satisfying, can be discarded pressing **DISCARD**.

DISCARD and **ACCEPT** buttons are replicated on the Touchscreen

Chapter 4

4 - QAS Worksheet

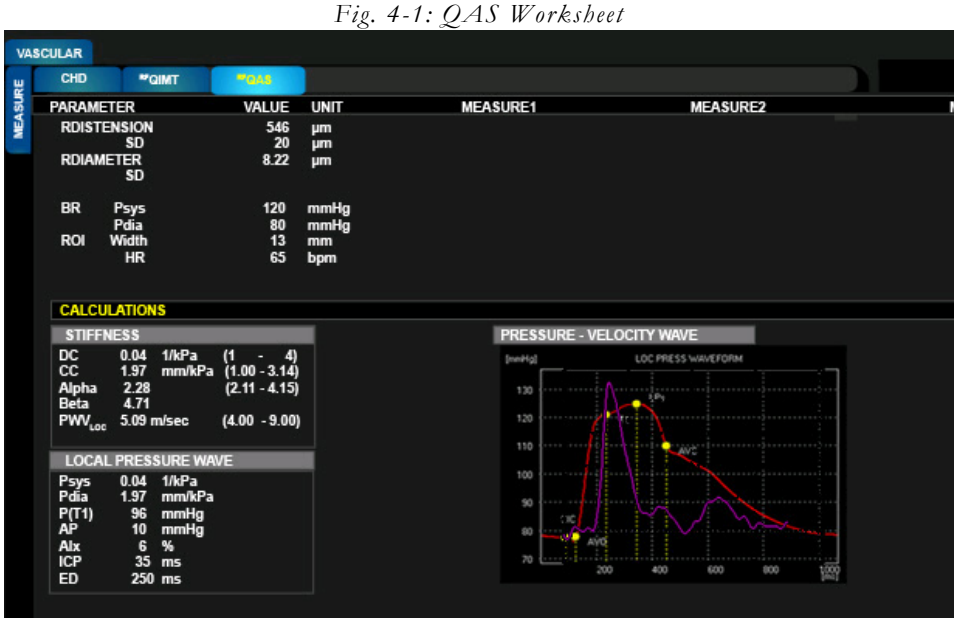
This chapter explains the structure of the QAS worksheet.

Worksheet Organization

Once QAS measurements have been performed, the Vascular Worksheet includes a dedicated folder containing the relevant QAS measurements and graphics.

Two separate pages are available for left and right Common Carotid Artery.

Fig. 4-1: QAS Worksheet



QAS Worksheet folder consists of 3 sections:

- Measure,
- Calculation,
- Pressure - Velocity Waveforms.

QAS Measurements Section

The page contains the Average and Standard Deviation of both the Distension and the Diastolic Diameter of the vessel under measurement. The page also reports the entered Brachial Systolic (Psys) and Diastolic (Pdia) Pressure values.

In addition are present the dimension in millimeters of the ROI width and height, and the Heart Rate (HR) in beats per minute.

QAS Calculations Section

The Worksheet Calculations page includes the following measures that are automatically calculated by the system:

- Distensibility Coefficient (DC),
- Compliance Coefficient (CC),
- Alpha Stiffness (α),
- Beta Stiffness (β),
- Pulse Wave Velocity (PWV),
- Local Blood Pressure – Systolic (Psys),
- Local Blood Pressure – Diastolic (Pdia),
- Pressure at T1 (P(T1)),
- Augmented Pressure (AP),
- Augmentation Index (AIx),
- Isovolumic Contraction Period (ICP),
- Ejection Duration (ED).

QAS Pressure - Velocity Waveforms Section

The Worksheet Calculations page includes the plot of the Averaged Pressure and Velocity waveforms.

There are two scales represented on the Y-axis of the graph: at the left side a scale in pressure values [mmHg]; at the right side a scale in velocity values [m/sec].

The two waveforms are rescaled to fit the same graph area.

The Local Pressure Waveform is obtained by transforming the last six cycles of the distension curve over time in one pressure curve over time. On the Pressure Waveform the following points are indicated:

- Start of Isovolumetric Contraction (SIC),
- Aortic Valve Opening (AVO),
- Inflection Point (T1),
- Pressure At Inflection Point (P(T1)),
- Local Systolic Pressure (LPsys),
- Aortic Valve Closure (AVC).

If pressure values (Psys, Pdia) are not entered in PatientID or Realtime Preview window, then the Pressure Waveform is displayed as Distension Waveform. In this case the vertical scale is in micrometers.

By hovering the mouse pointer on the graph, the values for each point of the waveforms are displayed.

QAS Report Section

A dedicated section for QAS measure / calculation / graph is provided for QAS.

This section is replicated for Left and Right.

The QAS section is divided for Left and Right, the two subsections can be tilted horizontally, not vertically as it is for all other Lateral Measures.

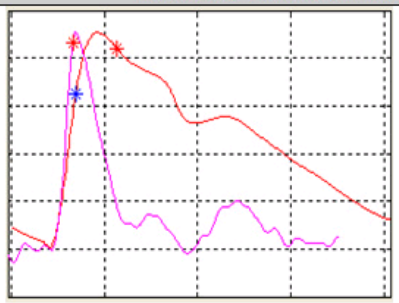
Fig. 4-2: QAS Report

Measurements	Value	Unit	Measurements	Value	Unit
Distension	523	µm	Brachial Psys	120	mmHg
SD	21	µm	Pdia	80	mmHg
Diameter	6.23	mm			
SD	0.2	mm	Region Width	13	mm
			HR	65	bpm

STIFFNESS		
DC	0.04	1/KPa
CC	1.97	mm/Kpa
Alpha	2.28	
Beta	4.71	
PWV_{LOC}	5.09	m/sec

LOCAL PRESSURE		
Psys	105	mmHg
Pdia	76	mmHg
P(T1)	95	mmHg
AP	10	mmHg
Aix	6	%
ICP	35	ms
ED	250	ms

PRESSURE – VELOCITY WAVEFORM



Chapter 5

5 - QAS Measurement Set Up

This chapter explains how to configure the specific setting of the QAS measurement.

QAS Measurements

Once the QAS licence is installed, the QAS group is displayed in the "Application Measurements" folder of the Vascular application.

Table 5-1: Parameters in the QAS group

Parameter	Label
DISTENSION	DIST
QAS standard deviation	SD
Vessel diameter	DIAMETER
Standard deviation of vessel diameter	SD
Brachial Systolic Pressure	BrP sys
Brachial Diastolic Pressure	BrP dia

Appendix

A

A. Bibliographic References for QAS Calculations

QAS

Distensibility Coefficient

Formula	Measure unit	Derived parameters
$DC = \frac{\Delta A}{A \cdot \Delta p} = \frac{2 \cdot D \cdot \Delta D + \Delta D^2}{D^2 \cdot \Delta p}$	kPa^{-1}	-
A: Diastolic area		
ΔA: Change of area in systole		
D: Diastolic diameter		
ΔD: Change of diameter in systole		
Δp: Local pulse pressure		
Meinders J.M., Hoeks A.P.G. "Simultaneous assessment of diameter and pressure waveforms in the carotid artery" In: *Ultrasound Med Biol 2004; 30: 147-154.* (Meinders, Hoeks, 2004)		

Compliance Coefficient

Formula	Measure unit	Derived parameters
$CC = \frac{\Delta A}{\Delta p} = \frac{\pi \cdot \left(2 \cdot D \cdot \Delta D + \Delta D^2\right)}{4 \cdot \Delta p}$	mm^2kPa^{-1}	-
ΔA: Change of area in systole		
D: Diastolic diameter		
ΔD: Change of diameter in systole		
Δp: Local pulse pressure		
Meinders J.M., Hoeks A.P.G. "Simultaneous assessment of diameter and pressure waveforms in the carotid artery" In: *Ultrasound Med Biol 2004; 30: 147-154.* (Meinders, Hoeks, 2004)		

Alfa Stiffness

Formula	Measure unit	Derived parameters
$\alpha = \frac{A \cdot \ln\left(p_s / p_d\right)}{\Delta A} = \frac{D^2 \cdot \ln\left(p_s / p_d\right)}{2 \cdot D \cdot \Delta D + \Delta D^2}$	-	-
A: Diastolic area		
ΔA: Change of area in systole		
D: Diastolic diameter		
ΔD: Change of diameter in systole		
Ps: Systolic pressure		
Pd: Diastolic pressure		
Meinders J.M., Hoeks A.P.G. "Simultaneous assessment of diameter and pressure waveforms in the carotid artery" In: *Ultrasound Med Biol 2004; 30: 147-154.* (Meinders, Hoeks, 2004)		

Beta Stiffness

Formula	Measure unit	Derived parameters
$\beta = \frac{D \cdot \ln(p_s / p_d)}{\Delta D}$	-	-
D: Diastolic diameter		
ΔD: Change of diameter in systole		
Ps: Systolic pressure		
Pd: Diastolic pressure		
D Vinereanu, W Nicolaides, L Boden, N Payne, C Jones, A Fraser "Conduit arterial stiffness is associated with impaired left ventricular sub-endocardial function" In *Heart, 2003 April; 89(4): 449-450*		

Pulse Wave Velocity

Formula	Measure unit	Derived parameters
$PWV = \frac{1}{\sqrt{\rho \cdot DC}} = \sqrt{\frac{D^2 \cdot \Delta p}{\rho \cdot (2 \cdot D \cdot \Delta D + \Delta D^2)}}$	ms^{-1}	-
D: Diastolic diameter		
ΔD: Change of diameter in systole		
DC: Distensibility coefficient		
Δp: Local pulse pressure		
ρ: Blood density		
Meinders J.M., Hoeks A.P.G. "Simultaneous assessment of diameter and pressure waveforms in the carotid artery" In: *Ultrasound Med Biol 2004; 30: 147-154.* (Meinders, Hoeks, 2004)		

Augmented Pressure

Formula	Measure unit	Derived parameters
AP=Loc Psys – P(T1)	mmHg	**-**
Loc Psys: Local pressure - systolic		
P(T1): Pressure at T1		

R. Kelly, MB, FRACP, C. Hayward, MB, BSc, A. Avolio, PhD, and M. O'Rourke, MD, "Noninvasive Determination of Age-Related Changes in the Human Arterial Pulse" In: *Circulation* 1989;80;1652-1659

Augmentation Index

Formula	Measure unit	Derived parameters
AIx=[AP/(Loc Psys – Loc Pdia)]*100	-	**-**
AP: Augmented pressure		
Loc Psys: Local pressure - systolic		
Loc Pdia: Local pressure - diastolic		

R. Kelly, MB, FRACP, C. Hayward, MB, BSc, A. Avolio, PhD, and M. O'Rourke, MD, Noninvasive Determination of Age-Related Changes in the Human Arterial Pulse, *Circulation* 1989;80;1652-1659

Isovolumic Contraction Period

Formula	Measure unit	Derived parameters
ICP= AVC-AVO	ms	**-**
AVC: Aortic Valve Closure		
AVO: Aortic Valve Opening		

Koen D. Reesink, Evelien Hermeling,M. Christianne Hoeberigs,
Robert S. Reneman,and Arnold P. G. Hoeks, "Carotid artery pulse wave time characteristics to quantify ventriculoarterial responses to orthostatic challenge", Departments of Biophysics, Radiology, and Physiology, Cardiovascular Research Institute Maastricht, Maastricht University, Maastricht, The Netherlands
J Appl Physiol 102:2128-2134, 2007. First published Feb 22, 2007; doi:10.1152/ japplphysiol.01206.2006

Ejection Duration

Formula	Measure unit	Derived parameters
ED= AVO-SIC	ms	**-**
AVO: Aortic Valve Opening		
SIC: Start of Isovolumic Contraction		

Koen D. Reesink, Evelien Hermeling,M. Christianne Hoeberigs,
Robert S. Reneman,and Arnold P. G. Hoeks, "Carotid artery pulse wave time characteristics to quantify ventriculoarterial responses to orthostatic challenge", Departments of Biophysics, Radiology, and Physiology, Cardiovascular Research Institute Maastricht, Maastricht University, Maastricht, The Netherlands,
J Appl Physiol 102:2128-2134, 2007. First published Feb 22, 2007; doi:10.1152/ japplphysiol.01206.2006

B. QAS Reference Tables

Howard Tables

Normal values in common carotid.

Black Population

Female - Left Side

Age (years)	25% (mm)	50% (mm)	75% (mm)
45	0.49	0.56	0.64
55	0.56	0.65	0.75
65	0.62	0.72	0.85

Female - Right Side

Age (years)	25% (mm)	50% (mm)	75% (mm)
45	0.51	0.58	0.65
55	0.59	0.68	0.78
65	0.63	0.74	0.85

Male - Left Side

Age (years)	25% (mm)	50% (mm)	75% (mm)
45	0.53	0.62	0.72
55	0.61	0.71	0.83
65	0.69	0.82	0.99

Male - Right Side

Age (years)	25% (mm)	50% (mm)	75% (mm)
45	0.52	0.61	0.71
55	0.61	0.72	0.84
65	0.72	0.85	1.01

White Population

Female - Left Side

Age (years)	25% (mm)	50% (mm)	75% (mm)
45	0.47	0.54	0.61
55	0.54	0.62	0.71
65	0.61	0.71	0.81

Female - Right Side

Age (years)	25% (mm)	50% (mm)	75% (mm)
45	0.47	0.53	0.61
55	0.55	0.62	0.71
65	0.60	0.69	0.81

Male - Left Side

Age (years)	25% (mm)	50% (mm)	75% (mm)
45	0.52	0.60	0.70
55	0.59	0.68	0.80
65	0.65	0.77	0.93

Male - Right Side

Age (years)	25% (mm)	50% (mm)	75% (mm)
45	0.50	0.57	0.66
55	0.57	0.66	0.77
65	0.65	0.76	0.90

Reference

G.Howard, AR.Sharrett, G.Heiss, GW.Evans, LE.Chambless, WA.Riley and GL.Burke "Carotid artery intimal-medial thickness distribution in general populations as evaluated by B-mode ultrasound" In: *ARIC Investigators Stroke*, 1993;24;1297-1304 1993

Howard Extended Tables

Normal values in common carotid.

Black Population

Female

Age (years)	(mm)
25	390
35	490
45	590
55	580
65	760
75	860

Male

Age (years)	(mm)
25	440
35	540
45	640
55	740
65	870
75	970

White Population

Female

Age (years)	(mm)
25	350
35	450
45	550
55	640
65	730
75	830

Male

Age (years)	(mm)
25	400
35	500
45	610
55	700
65	800
75	900

Reference

G.Howard, AR.Sharrett, G.Heiss, GW.Evans, LE.Chambless, WA.Riley and GL.Burke "Carotid artery intimal-medial thickness distribution in general populations as evaluated by B-mode ultrasound" In: *ARIC Investigators Stroke*, 1993;24;1297-1304 1993

MESA Tables

Normal values in common carotid.

Black Population

Female - Left Side

Age (years)	25% (mm)	50% (mm)	75% (mm)
45	0.54	0.63	0.73
54	0.54	0.63	0.73
55	0.59	0.67	0.80
64	0.59	0.67	0.80
65	0.63	0.76	0.90
74	0.63	0.76	0.90
75	0.68	0.78	0.91
84	0.68	0.78	0.91

Female - Right Side

Age (years)	25% (mm)	50% (mm)	75% (mm)
45	0.55	0.64	0.74
54	0.55	0.64	0.74
55	0.60	0.71	0.81
64	0.60	0.71	0.81
65	0.65	0.76	0.92
74	0.65	0.76	0.92
75	0.71	0.83	0.96
84	0.71	0.83	0.96

Male - Left Side

Age (years)	25% (mm)	50% (mm)	75% (mm)
45	0.56	0.69	0.81
54	0.56	0.69	0.81
55	0.63	0.75	0.92
64	0.63	0.75	0.92
65	0.69	0.82	0.99
74	0.69	0.82	0.99
75	0.72	0.85	1.02
84	0.72	0.85	1.02

Male - Right Side

Age (years)	25% (mm)	50% (mm)	75% (mm)
45	0.58	0.67	0.89
54	0.58	0.67	0.89
55	0.61	0.74	1.05
64	0.61	0.74	1.05
65	0.71	0.85	1.11
74	0.71	0.85	1.11
75	0.74	0.85	1.13
84	0.74	0.96	1.13

White Population

Female - Left Side

Age (years)	25% (mm)	50% (mm)	75% (mm)
45	0.50	0.58	0.67
54	0.50	0.58	0.67
55	0.55	0.64	0.75
64	0.55	0.64	0.75
65	0.63	0.73	0.85
74	0.63	0.73	0.85
75	0.70	0.80	0.94
84	0.70	0.80	0.94

Female - Right Side

Age (years)	25% (mm)	50% (mm)	75% (mm)
45	0.51	0.58	0.79
54	0.51	0.58	0.79
55	0.55	0.65	0.88
64	0.55	0.65	0.88
65	0.65	0.75	1.00
74	0.65	0.75	1.00
75	0.72	0.83	1.07
84	0.72	0.94	

Male - Left Side

Age (years)	25% (mm)	50% (mm)	75% (mm)
45	0.54	0.63	0.78
54	0.54	0.63	0.78
55	0.57	0.69	0.82
64	0.57	0.69	0.82
65	0.67	0.81	0.95
74	0.67	0.81	0.95
75	0.71	0.85	1.00
84	0.71	0.85	1.00

Male - Right Side

Age (years)	25% (mm)	50% (mm)	75% (mm)
45	0.52	0.62	0.71
54	0.52	0.62	0.71
55	0.57	0.68	0.81
64	0.57	0.68	0.81
65	0.65	0.77	0.92
74	0.65	0.77	0.92
75	0.72	0.83	0.97
84	0.72	0.83	0.97

Chinese Population

Female - Left Side

Age (years)	25% (mm)	50% (mm)	75% (mm)
45	0.49	0.58	0.67
54	0.49	0.58	0.67
55	0.52	0.63	0.72
64	0.52	0.63	0.72
65	0.58	0.71	0.87
74	0.58	0.71	0.87
75	0.64	0.76	0.94
84	0.64	0.76	0.94

Female - Right Side

Age (years)	25% (mm)	50% (mm)	75% (mm)
45	0.55	0.60	0.70
54	0.55	0.60	0.70
55	0.54	0.63	0.77
64	0.54	0.63	0.77
65	0.59	0.71	0.84
74	0.59	0.71	0.84
75	0.67	0.77	0.96
84	0.67	0.77	0.96

Male - Left Side

Age (years)	25% (mm)	50% (mm)	75% (mm)
45	0.55	0.63	0.73
54	0.55	0.63	0.73
55	0.57	0.70	0.84
64	0.57	0.70	0.84
65	0.62	0.72	0.86
74	0.62	0.72	0.86
75	0.69	0.84	0.97
84	0.69	0.84	0.97

Male - Right Side

Age (years)	25% (mm)	50% (mm)	75% (mm)
45	0.54	0.64	0.73
54	0.54	0.64	0.73
55	0.56	0.70	0.83
64	0.56	0.70	0.83
65	0.62	0.73	0.92
74	0.62	0.73	0.92
75	0.66	0.79	0.98
84	0.66	0.79	1.07

Hispanic Population

Female - Left Side

Age (years)	25% (mm)	50% (mm)	75% (mm)
45	0.51	0.58	0.68
54	0.51	0.58	0.68
55	0.58	0.68	0.79
64	0.58	0.68	0.79
65	0.62	0.72	0.86
74	0.62	0.72	0.86
75	0.68	0.77	0.91
84	0.68	0.77	0.91

Female - Right Side

Age (years)	25% (mm)	50% (mm)	75% (mm)
45	0.51	0.58	0.67
54	0.51	0.58	0.67
55	0.57	0.69	0.77
64	0.57	0.69	0.777
65	0.65	0.76	0.87
74	0.65	0.76	0.87
75	0.63	0.78	0.92
84	0.63	0.78	0.92

Male - Left Side

Age (years)	25% (mm)	50% (mm)	75% (mm)
45	0.55	0.64	0.75
54	0.55	0.64	0.75
55	0.61	0.72	0.85
64	0.61	0.72	0.85
65	0.68	0.80	0.98
74	0.68	0.80	0.98
75	0.72	0.86	0.97
84	0.72	0.86	0.97

Male - Right Side

Age (years)	25% (mm)	50% (mm)	75% (mm)
45	0.53	0.62	0.73
54	0.53	0.62	0.73
55	0.60	0.67	0.82
64	0.60	0.67	0.82
65	0.65	0.78	0.90
74	0.65	0.78	0.90
75	0.71	0.81	0.92
84	0.71	0.81	0.92

Reference

James H.Stein, Claudia E.Korcarz, R.Todd Hurst, Eva Lonn, Christopher B.Kendall, Emile R.Mohler "ASE CONSENSUS STATEMENT: Use of Carotid Ultrasound to Identify Subclinical Vascular Disease and Evaluate Cardiovascular Disease Risk: A Consensus Statement from the American Society of Echocardiography", American Society of Echocardiography, 2008

CAPS Tables

Normal values in common carotid.

White Population

Female

Age (years)	25% (mm)	50% (mm)	75% (mm)
25	0.524	0.567	0.612
35	0.575	0.615	0.66
45	0.619	0.665	0.713
55	0.665	0.719	0.776
65	0.718	0.778	0.852
75	0.771	0.837	0.921
85	0.807	0.880	0.935

Male

Age (years)	25% (mm)	50% (mm)	75% (mm)
25	0.515	0.567	0.633
35	0.585	0.633	0.682
45	0.634	0.686	0.756
55	0.680	0.746	0.837
65	0.745	0.830	0.921
75	0.814	0.914	1.028
85	0.830	0.937	1.208

Reference

James H.Stein, Claudia E.Korcarz, R.Todd Hurst, Eva Lonn, Christopher B.Kendall, Emile R.Mohler "ASE CONSENSUS STATEMENT: Use of Carotid Ultrasound to Identify Subclinical Vascular Disease and Evaluate Cardiovascular Disease Risk: A Consensus Statement from the American Society of Echocardiography", American Society of Echocardiography, 2008

Artery Tables

Normal values in common carotid.

Female

Age (years)	25% (µm)	50% (µm)	75% (µm)
15	351	396	441
20	373	421	469
25	395	446	497
30	417	471	524
35	439	496	552
40	461	521	580
45	483	545	607
50	506	570	635
55	528	595	663
60	550	620	690
65	572	645	718
70	594	670	745
75	616	694	773
80	638	719	801
85	660	744	828

Male

Age (years)	25% (µm)	50% (µm)	75% (µm)
15	354	401	449

Age (years)	25% (μm)	50% (μm)	75% (μm)
20	377	427	478
25	400	453	507
30	423	479	536
35	446	505	565
40	468	531	594
45	491	557	624
50	514	583	653
55	537	609	682
60	560	635	711
65	583	662	740
70	606	688	769
75	629	714	798
80	652	740	827
85	675	766	856

Reference

L.Engelen, I.Ferreira, C.D.Stehouwer et al. "Reference Intervals for Common Carotid Intima-Media Thickness Measured with Echotracking: Relation with Risk Factor", European Heart J, 2012, Nov