Core Modality 1: Carotid Duplex Evidence

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Protocol Document

Introduction and scope:

The presence and severity of disease of the extracranial arteries is assessed in order to plan therapy. Referral criteria are for patients with symptoms of cerebrovascular disease (stroke, transient ischaemic attacks or amaurosis fugax), carotid bruits, known risk of vascular disease, pre CABG or Tx workup.

Responsibilities:

Test staff: scientific or technical staff trained in vascular duplex scanning.

Equipment:

Duplex scanner with broadband linear array transducer.

Method:
Initial scanning is performed in a transverse plane in B-mode from the origin of the CCA (looking at the proximal subclavian where possible) to the bifurcation and distally, as far as the ICA and ECA can be followed. This is then repeated with colour flow imaging in transverse. Note any disease. In a longitudinal plane, flow waveforms of the CCA (mid-distal CCA), ECA and ICA (2-6cm beyond the bulb) are recorded and peak systolic and end diastolic velocities are measured in the CCA and ICA. Locate the vertebral artery and obtain a flow waveform. Note any abnormality in the direction or shape.

If disease is located, measure velocities pre stenosis and within stenosis. For lesions <50% B-mode with or without colour flow is used to measure the diameter reduction in the plane of greatest stenosis. When measuring velocities the Doppler angle should be 60 degrees or less and parallel with the flow of blood. Identify plaque characteristics (smooth, irregular, homogeneous, heterogeneous, calcified). For lesions (>50%) in the ICA, use velocity measurements as a guide to the degree of stenosis where appropriate.

On patients with poor access, or who are moving excessively, it is acceptable to not record velocities if genuinely not possible, and describe any plaque on its colour and b-mode appearance.

When grading ICA stenosis use the Kings College Hospital velocity criteria, in table 1.. If suspicious that the velocity and ultrasound appearance of a stenosis do not match, also use the joint recommendation criteria, in table 2. If any of the ratios are used, the CCA measurements should be made within 2cm of the carotid bifurcation.

Table 1: Kings College Hospital Criteria

Diameter reduction % ECST	Peak systolic velocity (m/s)
>50%	>1.25 m/s
>60%	>1.8 m/s
>70%	>2.3 m/s
>80%	>3.0 m/s

the flow of blood. Identify plaque characteristics (smooth, irregular, homogeneous, heterogeneous, calcified). For lesions (>50%) in the ICA, use velocity measurements as a guide to the degree of stenosis where appropriate.

On patients with poor access, or who are moving excessively, it is acceptable to not record velocities if genuinely not possible, and describe any plaque on its colour and b-mode appearance.

When grading ICA stenosis use the Kings College Hospital velocity criteria, in table 1.. If suspicious that the velocity and ultrasound appearance of a stenosis do not match, also use the joint recommendation criteria, in table 2. If any of the ratios are used, the CCA measurements should be made within 2cm of the carotid bifurcation.

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Diameter reduction % ECST	Peak systolic velocity (m/s)
>50%	>1.25 m/s
>60%	>1.8 m/s
>70%	>2.3 m/s
>80%	>3.0 m/s
>90%	>3.8 m/s

Table 2: Diameter reduction velocity criteria (Oates et al):

Percentage Stenosis (NASCET)	Internal carotid peak systolic velocity cm/sec	Peak systolic velocity ration ICA_{PSV} / CCA_{PSV}	St Mary's ratio[c] ICA_{PSV}/CCA_{EDV}
<50	<125[a]	<2[a]	<8
50-59	>125[a]	2-4[a]	8-10
60-69			11-13
70-79	>230[a]	>4[a]	14-21
80-89			22-29
>90 but less than near occlusion	>400[b]	>5[b]	>30
Near occlusion	High, Low – string flow	Variable	Variable
Occlusion	No flow	Not applicable	Not applicable

a Grant el al
b Filis et al
c Nicolaides et al

Reporting:

The findings should be reported on the CRIS system. The findings should cover velocities, plaque stenosis percentage and image description.

Inform vascular surgeons of significant findings.

Suggested images:

- Representative waveform and PSV and EDV measurements from CCA.
- Representative waveform and PSV and EDV measurements from ICA.
- Representative waveform from ECA.
- Representative waveforms from Vertebral artery.
- Images of other significant pathology reported on.
-

Inspection criteria:

Complete CRIS database patient tested/DNA/rebooked.

>90%	>3.8 m/s

Table 2: Diameter reduction velocity criteria (Oates et al):

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<50	<125[a]	<2[a]	<8
50-59	>125[a]	2-4[a]	8-10
60-69			11-13
70-79	>230[a]	>4[a]	14-21
80-89			22-29
>90 but less than near occlusion	>400[b]	>5[b]	>30
Near occlusion	High, Low – string flow	Variable	Variable
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- Representative waveforms from Vertebral artery.
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-

Inspection criteria:

Complete CRIS database patient tested/DNA/rebooked.

References:

Bluth EI et al.: Carotid duplex sonography; a multicenter recommendation for standardized imaging and Doppler criteria. Radoigraphics 6; 487-506 1988

Cole, S: Vascular Laboratory Practice: Part III. 1st edition. IPEM. York 2001.

Deane C: PgC Carotid vascular course notes. Kings College Hospital, 2001

Filis et al: Duplex ultrasound criteria for defining the severity of carotid stenosis. Ann Vasc Surg 2002 ; 16: 413-21

Grant et al: Carotid artery stenosis:grayscale and Doppler ultrasound diagnosis – society of radiologists in ultrasound consensus conference. Radiology 2003; 229:340-6

King=s College Hospital angiography and Duplex comparison studies.

Nicolaides et al: Angiographic and duplex grading of internal carotid stenosis: can we overcome confusion? J endovasc Surg 1996:3 :15/-65

Oates et al: Joint Recommendations for Reporting Carotid Ultrasound Investigations in the United Kingdom. European Society for Vascular Surgery 2009; 37, 251-261

Zwiebel WJ: Introduction to Vascular Ultrasonography.

Evidence – 25x Carotid Duplex Reports

RIGHT

				Waveform		Plaque Morphology		% Stenosis
CCA	PSV	0.70	m/s	NO	Normal	IR	Irregular plaque	10-19
	EDV	0.13	m/s					
Bulb						C	Calcified	30-39
ICA	PSV	1.03	m/s	NO	Normal	H	Heterogeneous	20-29
	EDV	0.23	m/s					
ECA				I	Increased velocities	H	Heterogeneous	>50
Vert				AN	Antegrade flow			

LEFT

				Waveform		Plaque Morphology		% Stenosis
CCA	PSV		m/s	NO	Normal	IR	Irregular plaque	10-19
	EDV		m/s					
Bulb						C	Calcified	30-39
ICA	PSV	1.07	m/s	NO	Normal	H	Heterogeneous	20-29
	EDV	0.32	m/s					
ECA				I	Increased velocities	H	Heterogeneous	>50
Vert				NO	Normal			

Comments:

Comments:

Bilaterally:

Normal colour flow, waveforms and velocities in the CCA and ICA. Vertebral arteries are patent with antegrade flow.

Irregular heterogenous (predominately hyperechoic) plaque identified along both CCA's.
Moderate dense calcified plaque identified in the carotid bulbs; with mild-moderate plaque extending into the proximal ICA's.
Raised velocities sampled at the right and left ECA origins, PSV 1.6 m/s and 2.4 m/s, respectively - suggestive of >50% stenoses.

Left CCA velocities not recorded due to technical error - however, flow observed was normal.

Conclusion:

Mild-moderate plaque seen throughout
ECA origin >50% stenoses (L>R)

Carotid duplex

RIGHT

				Waveform		Plaque Morphology		% Stenosis
CCA	PSV	1.27	m/s	NO	Normal	-	----------	0
	EDV	0.32	m/s					
Bulb						-	----------	0
ICA	PSV	0.96	m/s	NO	Normal	-	----------	0
	EDV	0.25	m/s					
ECA				NO	Normal	-	----------	0
Vert				AN	Antegrade flow			

LEFT

				Waveform		Plaque Morphology		% Stenosis
CCA	PSV	1.40	m/s	NO	Normal	-	----------	0
	EDV	0.34	m/s					
Bulb						-	----------	0
ICA	PSV	0.72	m/s	NO	Normal	-	----------	0
	EDV	0.32	m/s					
ECA				NO	Normal	-	----------	0
Vert				AN	Antegrade flow			

Comments:

Bilaterally:

Normal colour flow, waveforms and velocities in the carotid arteries. Vertebral arteries are patent with antegrade flow.

No significant change to velocities or spectral waveforms identified in the proximal ICA or Vertebral arteries with head positioned to the left or right; not supportive of any underlying external vascular compression or eagle syndrome - if clinically indicated, alternative imaging is needed to rule out for certain.

Conclusion:

No evidence of haemodynamically significant stenosis.

Carotid duplex

RIGHT

				Waveform		Plaque Morphology		% Stenosis
CCA	PSV	0.71	m/s	NO	Normal	-	----------	0
	EDV	0.22	m/s					
Bulb						H	Heterogeneous	~20
ICA	PSV	0.66	m/s	NO	Normal	-	----------	0
	EDV	0.29	m/s					
ECA				NO	Normal	-	----------	0
Vert				AN	Antegrade flow			

LEFT

				Waveform		Plaque Morphology		% Stenosis
CCA	PSV	0.70	m/s	NO	Normal	IT	Intimal thickening	10
	EDV	0.19	m/s					
Bulb						H	Heterogeneous	20-29
ICA	PSV	0.61	m/s	NO	Normal	-	----------	0
	EDV	0.20	m/s					
ECA				NO	Normal	-	----------	0
Vert				AN	Antegrade flow			

Comments:

Comments:

Bilaterally:

Normal colour flow, waveforms and velocities in the carotid arteries. Vertebral arteries are patent with antegrade flow.

Only mild smooth heterogenous plaque identified.

Conclusion:

No evidence of haemodynamically significant stenosis detected.

Carotid duplex

RIGHT				Waveform		Plaque Morphology		% Stenosis
CCA	PSV	0.90	m/s	NO	Normal	-	----------	0
	EDV	0.25	m/s					
Bulb						-	----------	0
ICA	PSV	0.92	m/s	NO	Normal	-	----------	0
	EDV	0.30	m/s					
ECA				NO	Normal	-	----------	0
Vert				AN	Antegrade flow			

LEFT				Waveform		Plaque Morphology		% Stenosis
CCA	PSV	1.13	m/s	NO	Normal	-	----------	0
	EDV	0.29	m/s					
Bulb						-	----------	0
ICA	PSV	0.77	m/s	NO	Normal	-	----------	0
	EDV	0.26	m/s					
ECA				NO	Normal	-	----------	0
Vert				AN	Antegrade flow			

Comments:

Comments:

Bilaterally:

Normal colour flow, waveforms and velocities in the carotid arteries. Vertebral arteries are patent with antegrade flow.

Conclusion:

No evidence of haemodynamically significant stenosis.

Carotid duplex

RIGHT

				Waveform		Plaque Morphology		% Stenosis
CCA	PSV	1.56	m/s	I	Increased velocities	-	----------	-
	EDV	0.36	m/s					
Bulb						-	----------	-
ICA	PSV	1.32	m/s	I	Increased velocities	-	----------	-
	EDV	0.49	m/s					
ECA				NO	Normal	-	----------	-
Vert				AN	Antegrade flow			

LEFT

				Waveform		Plaque Morphology		% Stenosis
CCA	PSV	1.52	m/s	I	Increased velocities	-	----------	-
	EDV	0.38	m/s					
Bulb						-	----------	-
ICA	PSV	1.98	m/s	I	Increased velocities	-	----------	-
	EDV	0.87	m/s					
ECA				NO	Normal	-	----------	-
Vert				AN	Antegrade flow			

Comments:

Right:
The ICA is tortuous with irregular diameters observed throughout (~4-6 mm), there are velocity increases in regions where the ICA is narrower (PSV ~1.7m/s).

There is no evidence of carotid dissection observed in the ICA.

The vertebral artery is patent with normal antegrade flow.

Left:
The ICA is tortuous with varying calibre. There is an irregular region at the mid ICA with raised velocities and localised dilatation measuring 6.5mm compared to 4.5 mm more proximally.
There is no evidence of thrombus within the dilated region.

Conclusion:
No significant interval change compared with previous scan (14/09/22).

No evidence of haemodynamically significant plaque or thrombus.

Left side has raised velocities and a mild dilated segment at mid ICA.
Right side quite irregular appearance this might be suggestive of connective tissue disease, FMD? Ehlers-Danlos?

Carotid duplex

RIGHT

				Waveform		Plaque Morphology		% Stenosis
CCA	PSV	0.90	m/s	NO	Normal	MP	Minor plaque	10
	EDV	0.28	m/s					
Bulb						H	Heterogeneous	10-19
ICA	PSV	0.77	m/s	NO	Normal	H	Heterogeneous	10-19
	EDV	0.22	m/s					
ECA				NO	Normal	M	Minor plaque	10
Vert				AN	Antegrade flow			

LEFT

				Waveform		Plaque Morphology		% Stenosis
CCA	PSV	0.99	m/s	NO	Normal	H	Heterogeneous	10-19
	EDV	0.31	m/s					
Bulb						MP	Minor plaque	10
ICA	PSV	0.81	m/s	NO	Normal	MP	Minor plaque	10
	EDV	0.30	m/s					
ECA				NO	Normal	MP	Minor plaque	10
Vert				AN	Antegrade flow			

Comments:

Comments:

Bilaterally:

Normal colour flow, waveforms and velocities in the carotid arteries. Vertebral arteries are patent with antegrade flow.

Only mild heterogenous plaque identified throughout the carotid arteries.

Conclusion:

No evidence of haemodynamically significant stenosis detected.

Carotid duplex

RIGHT

				Waveform		Plaque Morphology		% Stenosis
CCA	PSV	1.34	m/s	NO	Normal	IT	Intimal thickening	<10
	EDV	0.30	m/s					
Bulb						-	----------	0
ICA	PSV	0.95	m/s	NO	Normal	-	----------	0
	EDV	0.23	m/s					
ECA				NO	Normal	-	----------	0
Vert				AN	Antegrade flow			

LEFT

				Waveform		Plaque Morphology		% Stenosis
CCA	PSV	1.47	m/s	NO	Normal	IT	Intimal thickening	<10
	EDV	0.34	m/s					
Bulb						-	----------	0
ICA	PSV	0.56	m/s	NO	Normal	-	----------	0
	EDV	0.26	m/s					
ECA				NO	Normal	-	----------	0
Vert				AN	Antegrade flow			

Comments:

Comments:

Bilaterally:

Normal colour flow, waveforms and velocities in the carotid arteries. Vertebral arteries are patent with antegrade flow.

Intimal thickening identified along the CCA, bilaterally.

CIMT:

Right - 1.0 mm

Left - -1.2 mm

Carotid duplex

RIGHT

				Waveform		Plaque Morphology		% Stenosis
CCA	PSV	0.46	m/s	NO	Normal	H	Heterogeneous	10-19
	EDV	0.08	m/s					
Bulb						H	Heterogeneous	10-19
ICA	PSV	0.40	m/s	NO	Normal	H	Heterogeneous	10-19
	EDV	0.07	m/s					
ECA				NO	Normal	H	Heterogeneous	10-19
Vert				AN	Antegrade flow			

LEFT

				Waveform		Plaque Morphology		% Stenosis
CCA	PSV	0.52	m/s	NO	Normal	H	Heterogeneous	10-19
	EDV	0.10	m/s					
Bulb						C	Calcified	20-29
ICA	PSV	0.62	m/s	NO	Normal	H	Heterogeneous	10-19
	EDV	0.14	m/s					
ECA				NO	Normal	H	Heterogeneous	10-19
Vert				AN	Antegrade flow			

Comments:

Comments:

Bilaterally:

Normal colour flow, waveforms and velocities in the carotid arteries. Vertebral arteries are patent with antegrade flow.

Mild/moderate heterogenous/calcified plaque detected throughout.

Conclusion:

No evidence of haemodynamically significant stenosis.

Carotid duplex

RIGHT

				Waveform		Plaque Morphology		% Stenosis
CCA	PSV	0.99	m/s	NO	Normal	MP	Minor plaque	<10
	EDV	0.22	m/s					
Bulb						C	Calcified	10-19
ICA	PSV	0.45	m/s	NO	Normal	C	Calcified	10-19
	EDV	0.17	m/s					
ECA				NO	Normal	H	Heterogeneous	30-39
Vert				AN	Antegrade flow			

LEFT

				Waveform		Plaque Morphology		% Stenosis
CCA	PSV	0.64	m/s	NO	Normal	MP	Minor plaque	<10
	EDV	0.18	m/s					
Bulb						C	Calcified	10-19
ICA	PSV	0.62	m/s	NO	Normal	C	Calcified	<50
	EDV	0.18	m/s					
ECA				NO	Normal	H	Heterogeneous	10-19
Vert				AN	Antegrade flow			

Comments:

Right:
The carotid arteries are patent with normal velocities, waveforms and colourflow.
There is no evidence of haemodynamically significant carotid disease; just mild/moderate plaque.
The vertebral artery is patent with normal antegrade flow.

Of note, the origin of the CCA/brachiocephalic artery is tortuous.

Left:
The carotid arteries are patent with normal velocities, waveforms and colourflow.
There is no evidence of haemodynamically significant carotid disease; just mild/moderate plaque.
There is calcified plaque present in the origin of the ICA which is not haemodynamically significant, however it is difficult to estimate the plaque burden visually due to acoustic shadowing.
The vertebral artery is patent with normal antegrade flow.

Conclusion:
There is no evidence of haemodynamically significant carotid disease; just mild/moderate plaque.

Carotid duplex

RIGHT

				Waveform		Plaque Morphology		% Stenosis
CCA	PSV	1.05	m/s	NO	Normal	MP	Minor plaque	10
	EDV	0.22	m/s					
Bulb						H	Heterogeneous	10-19
ICA	PSV	0.76	m/s	NO	Normal	H	Heterogeneous	10-19
	EDV	0.32	m/s					
ECA				NO	Normal	H	Heterogeneous	10-19
Vert				AN	Antegrade flow			

LEFT

				Waveform		Plaque Morphology		% Stenosis
CCA	PSV	1.23	m/s	NO	Normal	MP	Minor plaque	10
	EDV	0.24	m/s					
Bulb						H	Heterogeneous	10-19
ICA	PSV	0.59	m/s	NO	Normal	H	Heterogeneous	10-19
	EDV	0.21	m/s					
ECA				NO	Normal	H	Heterogeneous	10-19
Vert				AN	Antegrade flow			

Comments:

Comments:

Bilaterally:

Technically challenging scan - incomplete views of mid-distal ICA. Where seen:
Normal colour flow, waveforms and velocities in the carotid arteries. Vertebral arteries are patent with antegrade flow.

Only mild heterogenous (predominately hyperechoic) plaque identified.

Conclusion:

No evidence of haemodynamically significant stenosis detected.

Carotid duplex

RIGHT

				Waveform		Plaque Morphology		% Stenosis
CCA	PSV	1.03	m/s	NO	Normal	-	----------	0
	EDV	0.17	m/s					
Bulb						H	Heterogeneous	10-19
ICA	PSV	0.41	m/s	NO	Normal	H	Heterogeneous	10-19
	EDV	0.11	m/s					
ECA				NO	Normal	H	Heterogeneous	10-19
Vert				AN	Antegrade flow			

LEFT

				Waveform		Plaque Morphology		% Stenosis
CCA	PSV	0.94	m/s	NO	Normal	-	----------	-
	EDV	0.20	m/s					
Bulb						H	Heterogeneous	10-19
ICA	PSV	0.47	m/s	NO	Normal	H	Heterogeneous	10-19
	EDV	0.10	m/s					
ECA				NO	Normal	H	Heterogeneous	10-19
Vert				AN	Antegrade flow			

Comments:

Comments:

Bilaterally:

Normal colour flow, waveforms and velocities in the carotid arteries. Vertebral arteries are patent with antegrade flow.

Only mild heterogenous (predominately hyperechoic) plaque identified.

Conclusion:

No evidence of haemodynamically significant stenosis detected.

Carotid duplex

RIGHT

				Waveform		Plaque Morphology		% Stenosis
CCA	PSV	1.03	m/s	NO	Normal	-	----------	0
	EDV	0.29	m/s					
Bulb						-	----------	0
ICA	PSV	0.56	m/s	NO	Normal	-	----------	0
	EDV	0.21	m/s					
ECA				NO	Normal	-	----------	0
Vert				AN	Antegrade flow			

LEFT

				Waveform		Plaque Morphology		% Stenosis
CCA	PSV	1.17	m/s	NO	Normal	-	----------	0
	EDV	0.30	m/s					
Bulb						-	----------	0
ICA	PSV	0.91	m/s	NO	Normal	-	----------	0
	EDV	0.34	m/s					
ECA				NO	Normal	-	----------	0
Vert				AN	Antegrade flow			

Comments:

Comments:

Bilaterally:

Normal colour flow, waveforms and velocities in the carotid arteries. Vertebral arteries are patent with antegrade flow.

Conclusion:

No evidence of haemodynamically significant stenosis.

Pt complains of periodic bouts of scalp tenderness, with additional visual disturbances, ?GCA - performed cursory investigation of superfical, parietal and frontal temporal arteries, bilaterally - all are vessels are patent and compressible, with no obvious evidence of halo sign detected. If detailed investigation still required, please make separate request.

RIGHT

				Waveform		Plaque Morphology		% Stenosis
CCA	PSV	0.97	m/s	NO	Normal	-	----------	0
	EDV	0.19	m/s					
Bulb						-	----------	0
ICA	PSV	0.74	m/s	NO	Normal	-	----------	0
	EDV	0.16	m/s					
ECA				NO	Normal	-	----------	0
Vert				AN	Antegrade flow			

LEFT

				Waveform		Plaque Morphology		% Stenosis
CCA	PSV	1.04	m/s	NO	Normal	MP	Minor plaque	10
	EDV	0.23	m/s					
Bulb						H	Heterogeneous	10-19
ICA	PSV	0.83	m/s	NO	Normal	H	Heterogeneous	10-19
	EDV	0.24	m/s					
ECA				I	Increased velocities	HO	Homogeneous	>50
Vert				AN	Antegrade flow			

Comments:

Comments:

Bilaterally:

Normal colour flow, waveforms and velocities sampled in the CCA and ICA. Vertebral arteries are patent with antegrade flow.

Mild heterogenous plaque sampled throughout left carotid arteries.

There is a moderate burden of homogenous hypoechoic plaque identified in the proximal ECA, causing raised velocities, PSV 2.8 m/s, suggestive of a >50% stenosis.

Conclusion:

Mild-moderate plaque identified in the left carotid arteries.

No evidence of haemodynamically significant stenosis in either CCA or ICA, bilaterally.

Carotid duplex

RIGHT

				Waveform		Plaque Morphology		% Stenosis
CCA	PSV	0.33	m/s	NO	Normal	H	Heterogeneous	10-19
	EDV	0.08	m/s					
Bulb						C	Calcified	60-69
ICA	PSV	2.06	m/s	I	Increased velocities	C	Calcified	60-69
	EDV	0.57	m/s					
ECA				I	Increased velocities	C	Calcified	>50
Vert				AN	Antegrade flow			

LEFT

				Waveform		Plaque Morphology		% Stenosis
CCA	PSV	0.47	m/s	NO	Normal	H	Heterogeneous	10
	EDV	0.14	m/s					
Bulb						C	Calcified	50-59
ICA	PSV	1.41	m/s	I	Increased velocities	C	Calcified	50-59
	EDV	0.46	m/s					
ECA				I	Increased velocities	C	Calcified	>50
Vert				AN	Antegrade flow			

Comments:

Right:

Heavy burden of dense calcified disease identified at carotid bulb level (~1 cm in length), which extends into the proximal ICA and ECA; appears to be causing at least a 60-69% proximal ICA and >50% ECA stenosis. However, please note there is suboptimal views due to acoustic shadowing. Distal ICA waveforms and velocities appear relatively normal, albeit, patient appears to have ?arrhythmia, that also effects waveform morphology.

Vertebral artery is patent with antegrade flow.

Left:

Heavy burden of dense calcified disease identified at carotid bulb level (~2 cm in length), which extends into the proximal ICA and ECA; appears to be causing at least a 50-59% proximal ICA and >50% ECA stenosis. However, please note there is suboptimal views due to acoustic shadowing. Distal ICA waveforms and velocities appear relatively normal, albeit, patient appears to have ?arrhythmia, that also effects waveform morphology.

Vertebral artery is patent with antegrade flow.

Conclusion:

R 60-69% ICA stenosis
L 50-59% ICA stenosis

R+L >50% ECA stenosis

Sent pt to head MRI and discussed result with vasc reg.

Carotid duplex

RIGHT

				Waveform		Plaque Morphology		% Stenosis
CCA	PSV	0.76	m/s	NO	Normal	-	----------	0
	EDV	0.18	m/s					
Bulb						H	Heterogeneous	10-19
ICA	PSV	0.45	m/s	NO	Normal	-	----------	0
	EDV	0.14	m/s					
ECA				NO	Normal	-	----------	0
Vert				AN	Antegrade flow			

LEFT

				Waveform		Plaque Morphology		% Stenosis
CCA	PSV	0.82	m/s	NO	Normal	-	----------	0
	EDV	0.19	m/s					
Bulb						H	Heterogeneous	10-19
ICA	PSV	0.47	m/s	NO	Normal	-	----------	0
	EDV	0.19	m/s					
ECA				NO	Normal	-	----------	0
Vert				AN	Antegrade flow			

Comments:

Comments:

Bilaterally:

Normal colour flow, waveforms and velocities in the carotid arteries. Vertebral arteries are patent with antegrade flow.

Only mild heterogenous plaque identified at carotid bulb level.

Conclusion:

No evidence of haemodynamically significant stenosis detected.

Carotid duplex

RIGHT

				Waveform		Plaque Morphology		% Stenosis
CCA	PSV	0.88	m/s	NO	Normal	MP	Minor plaque	<10
	EDV	0.26	m/s					
Bulb						H	Heterogeneous	10
ICA	PSV	0.90	m/s	NO	Normal	-	----------	0
	EDV	0.40	m/s					
ECA				NO	Normal	-	----------	0
Vert				AN	Antegrade flow			

LEFT

				Waveform		Plaque Morphology		% Stenosis
CCA	PSV	1.01	m/s	NO	Normal	MP	Minor plaque	10
	EDV	0.30	m/s					
Bulb						H	Heterogeneous	10
ICA	PSV	0.73	m/s	NO	Normal	-	----------	0
	EDV	0.32	m/s					
ECA				NO	Normal	-	----------	0
Vert				AN	Antegrade flow			

Comments:

Comments:

Bilaterally:

Normal colour flow, waveforms and velocities in the carotid arteries. Vertebral arteries are patent with antegrade flow.

Only minor heterogenous plaque identified.

Conclusion:

No evidence of haemodynamically significant stenosis detected.

RIGHT

				Waveform		Plaque Morphology		% Stenosis
CCA	PSV	0.71	m/s	NO	Normal	H	Heterogeneous	10-19
	EDV	0.15	m/s					
Bulb						H	Heterogeneous	20-29
ICA	PSV	0.62	m/s	NO	Normal	H	Heterogeneous	20-29
	EDV	0.04	m/s					
ECA				NO	Normal	H	Heterogeneous	10-19
Vert				AN	Antegrade flow			

LEFT

				Waveform		Plaque Morphology		% Stenosis
CCA	PSV	0.60	m/s	NO	Normal	H	Heterogeneous	10-19
	EDV	0.14	m/s					
Bulb						H	Heterogeneous	60-69
ICA	PSV	2.06	m/s	I	Increased velocities	H	Heterogeneous	60-69
	EDV	0.47	m/s					
ECA				I	Increased velocities	H	Heterogeneous	>50
Vert				NO	Normal			

Comments:

Right:

The carotid arteries are patent with normal flow and velocities. No evidence of significant stenosis, but minor plaque present.
The vertebral arteries are patent with normal antegrade flow.

Left:

The carotid arteries are patent. A heavy burden of heterogenous (predominately hyperechoic) plaque identified at carotid bulb level; resulting in increased velocities in the bulb and proximal ICA/ECA suggestive of an upper limit 60-69% stenosis.

The vertebral arteries are patent with normal antegrade flow.

Conclusion:

Left bulb/proximal ICA stenosis ~60-69%.
No significant interval change compared with previous scan (12/08/22).

RIGHT

				Waveform		Plaque Morphology		% Stenosis
CCA	PSV	0.95	m/s	NO	Normal	H	Heterogeneous	10-19
	EDV	0.17	m/s					
Bulb						H	Heterogeneous	50-59
ICA	PSV	1.86	m/s	I	Increased velocities	H	Heterogeneous	60-69
	EDV	0.61	m/s					
ECA				I	Increased velocities	H	Heterogeneous	>50
Vert				I	Increased velocities			

LEFT

				Waveform		Plaque Morphology		% Stenosis
CCA	PSV	0.94	m/s	NO	Normal	H	Heterogeneous	20-29
	EDV	0.26	m/s					
Bulb						H	Heterogeneous	50-59
ICA	PSV	1.29	m/s	I	Increased velocities	H	Heterogeneous	50-59
	EDV	0.43	m/s					
ECA				I	Increased velocities	H	Heterogeneous	>50
Vert				DF	Damped flow			

Comments:

Comments:

Right:

There remains significant stenoses at the ICA and ECA origins; raised velocities at ICA origin suggestive of worsening stenosis compared with previous scan (07/09/22), today velocities are more suggestive of a 60-69%. Raised velocities also sampled in the ECA origin (PSV 1.9 m/s), suggestive of >50% stenosis.
Increased velocities (PSV 4.8m/s) at the VertA origin indicative of tight stenosis (>75%). Also there are raised velocities at mid vertebral, suggestive of a further >50% stenosis. Distally the VertA is patent with dampened flow (PSV 0.4 m/s).

Left:

There remains an 50-59% stenosis in the ICA and >50% stenosis in the ECA.
Origin of the VertA appears occluded. Flow appears to recanalise at mid neck level with dampened waveforms.

RIGHT

				Waveform		Plaque Morphology		% Stenosis
CCA	PSV	1.08	m/s	NO	Normal	MP	Minor plaque	<10
	EDV	0.32	m/s					
Bulb						MP	Minor plaque	10-19
ICA	PSV	0.77	m/s	NO	Normal	-	----------	0
	EDV	0.22	m/s					
ECA				NO	Normal	-	----------	0
Vert				AN	Antegrade flow			

LEFT

				Waveform		Plaque Morphology		% Stenosis
CCA	PSV	0.87	m/s	NO	Normal	MP	Minor plaque	<10
	EDV	0.25	m/s					
Bulb						MP	Minor plaque	10-19
ICA	PSV	1.00	m/s	NO	Normal	-	----------	-
	EDV	0.33	m/s					
ECA				NO	Normal	-	----------	-
Vert				AN	Antegrade flow			

Comments:

Comments:

Bilaterally:

Normal colour flow, waveforms and velocities in the carotid arteries. Vertebral arteries are patent with antegrade flow.

Minor plaque identified along the CCA and at carotid bulb level.
Both ICA's appear tortuous (R>L), however, no significant velocities increase identified.

Conclusion:

No evidence of haemodynamically significant stenosis.

Spot check of Abdominal Aorta:

Generally poor views due to bowel gas. However, where seen, the distal abdominal aorta is patent and of normal calibre, maximal diameter measured 1.1 cm, AP.

Carotid duplex

RIGHT

				Waveform		Plaque Morphology		% Stenosis
CCA	PSV	0.89	m/s	NO	Normal	MP	Minor plaque	<10
	EDV	0.20	m/s					
Bulb						H	Heterogeneous	10-19
ICA	PSV	0.67	m/s	NO	Normal	H	Heterogeneous	10
	EDV	0.18	m/s					
ECA				NO	Normal	H	Heterogeneous	10
Vert				AN	Antegrade flow			

LEFT

				Waveform		Plaque Morphology		% Stenosis
CCA	PSV	0.95	m/s	NO	Normal	MP	Minor plaque	<10
	EDV	0.17	m/s					
Bulb						H	Heterogeneous	10-19
ICA	PSV	0.66	m/s	NO	Normal	H	Heterogeneous	10
	EDV	0.22	m/s					
ECA				NO	Normal	H	Heterogeneous	10
Vert				AN	Antegrade flow			

Comments:

Comments:

Bilaterally:

Normal colour flow, waveforms and velocities in the carotid arteries. Vertebral arteries are patent with antegrade flow.

Mild smooth heterogenous (predominately hyperechoic) plaque identified throughout the carotid arteries.

Conclusion:

No evidence of haemodynamically significant stenosis detected.

US Doppler carotid artery Both

Carotid duplex

RIGHT

				Waveform		Plaque Morphology		% Stenosis
CCA	PSV	0.61	m/s	NO	Normal	-	----------	0
	EDV	0.18	m/s					
Bulb						-	----------	0
ICA	PSV	0.79	m/s	NO	Normal	-	----------	0
	EDV	0.31	m/s					
ECA				NO	Normal	-	----------	0
Vert				AN	Antegrade flow			

LEFT

				Waveform		Plaque Morphology		% Stenosis
CCA	PSV	0.70	m/s	NO	Normal	-	----------	0
	EDV	0.20	m/s					
Bulb						-	----------	0
ICA	PSV	0.71	m/s	NO	Normal	-	----------	0
	EDV	0.30	m/s					
ECA				NO	Normal	-	----------	0
Vert				AN	Antegrade flow			

Comments:

Comments:

Bilaterally:

Normal colour flow, waveforms and velocities in the carotid arteries. Vertebral arteries are patent with antegrade flow.

Conclusion:

No evidence of haemodynamically significant stenosis.

RIGHT

				Waveform		Plaque Morphology		% Stenosis
CCA	PSV	1.08	m/s	NO	Normal	-	----------	0
	EDV	0.32	m/s					
Bulb						-	----------	0
ICA	PSV	0.63	m/s	NO	Normal			0
	EDV	0.26	m/s					
ECA				NO	Normal	-	----------	0
Vert				AN	Antegrade flow			

LEFT

				Waveform		Plaque Morphology		% Stenosis
CCA	PSV	0.76	m/s	NO	Normal	-	----------	0
	EDV	0.24	m/s					
Bulb						-	----------	0
ICA	PSV	0.62	m/s	NO	Normal	-	----------	0
	EDV	0.28	m/s					
ECA				NO	Normal	-	----------	0
Vert				AN	Antegrade flow			

Comments:

Comments:

Bilaterally:

Technically challenging scan due to vessel tortuosity, high carotid bifurcation and thick neck/body habitus. Where seen:

Normal colour flow, waveforms and velocities in the carotid arteries - poor views of distal ICA's, however, normal waveforms and velocities sampled proximally, not suggestive of significant distal stenosis; however, can not rule out the possibility minor narrowing.

Vertebral arteries are patent with antegrade flow.

Conclusion:

No evidence of haemodynamically significant stenosis detected.

US Doppler carotid artery Both

Carotid duplex

RIGHT

				Waveform		Plaque Morphology		% Stenosis
CCA	PSV	1.25	m/s	NO	Normal	-	----------	-
	EDV	0.15	m/s					
Bulb						H	Heterogeneous	10-19
ICA	PSV	1.10	m/s	NO	Normal	H	Heterogeneous	10-19
	EDV	0.17	m/s					
ECA				NO	Normal	H	Heterogeneous	10-19
Vert				AN	Antegrade flow			

LEFT

				Waveform		Plaque Morphology		% Stenosis
CCA	PSV	1.71	m/s	NO	Normal	-	----------	0
	EDV	0.17	m/s					
Bulb						H	Heterogeneous	10-19
ICA	PSV	0.87	m/s	NO	Normal	H	Heterogeneous	10-19
	EDV	0.16	m/s					
ECA				NO	Normal	H	Heterogeneous	10-19
Vert				AN	Antegrade flow			

Comments:

Comments:

Bilaterally:

Normal colour flow, waveforms and velocities in the carotid arteries. Vertebral arteries are patent with antegrade flow.

Mild heterogenous plaque identified in the carotid bulbs; extending into the proximal ICA/ECA.

Conclusion:

No evidence of haemodynamically significant stenosis detected.

RIGHT

				Waveform		Plaque Morphology		% Stenosis
CCA	PSV	0.88	m/s	NO	Normal	H	Heterogeneous	20-29
	EDV	0.21	m/s					
Bulb						H	Heterogeneous	20-29
ICA	PSV	0.51	m/s	NO	Normal	H	Heterogeneous	20-29
	EDV	0.15	m/s					
ECA				NO	Normal	H	Heterogeneous	<50
Vert				AN	Antegrade flow			

LEFT

				Waveform		Plaque Morphology		% Stenosis
CCA	PSV	0.71	m/s	NO	Normal	H	Heterogeneous	20-29
	EDV	0.20	m/s					
Bulb						H	Heterogeneous	20-29
ICA	PSV	0.93	m/s	NO	Normal	H	Heterogeneous	20-29
	EDV	0.24	m/s					
ECA				NO	Normal	H	Heterogeneous	20-29
Vert				AN	Antegrade flow			

Comments:

Comments:

Bilaterally:

Normal colour flow, waveforms and velocities in the carotid arteries. Vertebral arteries are patent with antegrade flow.

Mild-to-moderate smooth heterogenous (predominately hypoechoic) plaque identified throughout (20-29%).

Previous CT imaging (09/05/23) describes a 65% left carotid bulb/ICA stenosis; this was not seen in today scan - no raised velocities sampled and visually appears to be closer to a 20-29% narrowing.

Conclusion:

Mild-to-moderate disease seen throughout the carotid arteries (~20-29%).

No evidence of haemodynamically significant stenosis detected.

Carotid duplex

RIGHT

				Waveform		Plaque Morphology		% Stenosis
CCA	PSV	1.33	m/s	NO	Normal	-	----------	0
	EDV	0.21	m/s					
Bulb						H	Heterogeneous	10-19
ICA	PSV	0.98	m/s	NO	Normal	H	Heterogeneous	10-19
	EDV	0.33	m/s					
ECA				NO	Normal	H	Heterogeneous	10-19
Vert				AN	Antegrade flow			

LEFT

				Waveform		Plaque Morphology		% Stenosis
CCA	PSV	1.01	m/s	NO	Normal	-	----------	0
	EDV	0.27	m/s					
Bulb						H	Heterogeneous	10-19
ICA	PSV	0.97	m/s	NO	Normal	H	Heterogeneous	10-19
	EDV	0.33	m/s					
ECA				NO	Normal	H	Heterogeneous	10-19
Vert				AN	Antegrade flow			

Comments:

Comments:

Bilaterally:

Normal colour flow, waveforms and velocities in the carotid arteries. Vertebral arteries are patent with antegrade flow.

Mild heterogenous (predominately hyperechoic) plaque identified in the carotid bulbs extending into the proximal ICA/ECA.

Conclusion:

No evidence of haemodynamically significant stenosis detected.