ECST-2 PLAQUE IMAGING PROTOCOLS

REQUIREMENTS FOR PLAQUE IMAGING IN ECST-2

This document lists several different imaging protocols. Centres should choose which protocol to use based on their capabilities and interests. The basic protocol should be performed by all participating centres and is designed to detect the presence of intraplaque haemorrhage (IPH).

The advanced protocols, listed in the pages after the basic protocol, are optional add-on protocols that are available for centres interested in acquiring additional sequences to further characterize plaque burden and lipid rich necrotic core.

These imaging protocols are closely following the recommendations of the ASNR regarding the visualization of intraplaque hemorrhage, stenosis, and luminal condition.

Images obtained as part of the plaque imaging sub-study should be returned on CD to:

The Trial Manager, Box 6 The National Hospital, Queen Square London WC1N 3BG.

If the images are reported on at the centre by a radiologist the reports should be included as well.

Please also complete the form you will find at the end of this document and return it with each set of images you send to the central office

BASIC PROTOCOL to be performed at all participating centres

This basic protocol can be performed on 1.5T or 3T systems but 3T is preferable and requires two sequences, 3D TOF and 3D MP RAGE using the parameters in the table below**:**

Name	**3D TOF**	**3D MP-RAGE**
Plaque Feature	Stenosis, Ulceration, Calcification	Intraplaque Hemorrhage
Sequence[a]	FFE/SPGR	IR-TFE/SPGR
Image mode	3D	3D
Scan plane	Axial	Coronal
TR, msec	24	15
TE, msec	4.6	Min
FOV, cm	16x16	16x16
Resolution, mm^2	0.6x0.6	0.6x0.6
Slice thickness, mm	1[b]	0.6
Blood suppression	Saturation – veins	None
Special parameters	Flip angle 20°	Flip angle 15°; TI=500 ms Turbo factor = 30, IRTR=800ms
Fat suppression	No	Yes (Water Excitation)

[a] Siemens/Philips/GE acronyms.
[b] Interpolated resolution

*Pulse gating not required for any sequenc

OPTIONAL ADVANCED PLAQUE IMAGING SEQUENCES

The additional advanced imaging sequences should be performed at 3T, but can be acquired using a head-neck/neurovascular coil. The use of a dedicated carotid coil is not mandatory, but recommended, if available and time allows.

There are two options. On this page we give the recommended sequences for centres using intravenous contrast administration (e.g. following a contrast-enhanced MRA). The next page lists an alternative additional sequence protocol for centres which do not use gadolinium.

For each of these we give the option to use 3D or 2D imaging. The former is preferred.

OPTIONAL ADVANCED SEQUENCES WITH CONTRAST ADMINISTRATION

A 3D +C

Name	**Pre-contrast and post-contrast 3D T1w SPACE/CUBE/VISTA**
Plaque Feature	Plaque burden and distribution, LRNC
Sequence[a]	TSE/FSE
Image mode	3D
Scan plane	Coronal
TR, msec	1000
TE, msec	10
FOV, cm	16x16
Resolution, mm^2	0.6x0.6
Slice thickness, mm	0.6
Blood suppression	MSDE/FSD[c]
Special parameters	Echo train 50 VFA T1
Fat suppression	Yes

[c] MSDE: Motion-sensitized driven equilibrium, FSD: Flow sensitized dephasing

*Pulse gating not required for any sequence

A 2D +C

Name	**Pre-contrast and Post-contrast T1W**
Plaque feature	Plaque burden and distribution, LRNC
Sequence[a]	TSE
Image mode	2D
Scan plane	Axial
TR, msec	800
TE, msec	10
FOV, cm	16x16
Resolution, mm^2	0.63x0.63
Slice thickness, mm	2
# of slices	16
Blood suppression[b]	QIR
Special parameters	Echo train 10;
Fat suppression	Yes

QIR: Quadruple inversion recovery

OPTIONAL ADVANCED SEQUENCES WITHOUT CONTRAST ADMINISTRATION

A 3D -C

Name	**3D T1w SPACE/CUBE/VISTA**	**3D T2w SPACE/CUBE/VISTA**
Plaque Feature	Plaque burden and distribution	LRNC
Sequence[a]	TSE/FSE	TSE/FSE
Image mode	3D	3D
Scan plane	Coronal	Coronal
TR, msec	1000	2500
TE, msec	10	250
FOV, cm	16x16	16x16
Resolution, mm^2	0.6x0.6	0.6x0.6
Slice thickness, mm	0.6	0.6
Blood suppression	MSDE/FSD[c]	MSDE/FSD[c]
Special parameters	Echo train 50 VFA T1	Echo train 130 VFA T2
Fat suppression	Yes	Yes

A 2D -C

Name	**T1W**	**T2W**
Plaque feature	Plaque burden and distribution	LRNC
Sequence[a]	TSE	TSE
Image mode	2D	2D
Scan plane	Axial	Axial
TR, msec	800	4800
TE, msec	10	50
FOV, cm	16x16	16x16
Resolution, mm^2	0.63x0.63	0.63x0.63
Slice thickness, mm	2	2
# of slices	16	16
Blood suppression	DIR or QIR	
Special parameters	Echo train 10;	Echo train 12; 8 slices/TR
Fat suppression	Yes	Yes

DIR: Double inversion recovery

QIR: Quadruple inversion recovery

Discussion

IPH: MRI techniques are available for IPH detection across scanner platforms, and IPH's predictive value for ischemic events has been extensively evaluated, both with and without custom carotid coils. In a review performed by Gupta et al[2], studies were stratified by those utilizing multi-sequence, carotid coil-dependent protocols and those using a single sequence and standard neck coils for IPH detection. Using either technique, IPH was associated with significantly increased risk for TIA or stroke (HR (95% CI) 4.40 (2.10-9.23) and 5.04 (2.15-11.85), respectively). While IPH can be identified on T1w sequences such as T1w fast spin echo, T1w SPACE, TOF etc., a highly T1 weighted sequence such as MPRAGE can provide higher sensitivity and specificity for IPH detection[8].

Plaque burden and distribution: Knowledge of the location and distribution of plaque assists in pre-procedural planning.

Lipid-rich necrotic core: T2 weighted imaging can be used to detect the presence of LRNC[9, 10]. Direct assessment of LRNC can also be done in patients undergoing contrast administration using a post-contrast T1w scan. CE-MRA followed by post-CE vessel wall imaging in patients without contraindication will improve detection and quantification of the LRNC and delineation of the fibrous cap[11, 12].

REFERENCES:

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PLAQUE IMAGING RETURN FORM

Name of imaging centre…….

Please give the patients' ECST2 Trial number ……..……..

Date imaging performed……

Which plaque imaging protocol(s) did you perform (check all that apply):

Basic protocol	☐
Advanced 3D with contrast	☐
Advanced 2D with contrast	☐
Advanced 3D without contrast	☐
Advanced 2D without contrast	☐

Name and contact details of person returning images:

Name……

Address…….

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email……..