

Total Scan Time: ~ 65 minutes

## Short 3T MRI Protocol for Head, Neck & Azygus MS study With Contrast

(NOTE: Please follow the sequence order)

| <b>Head - with Contrast</b><br>(Center at the orbital ridge) |  |              |                 |                             |                                    |
|--|--|--------------|-----------------|-----------------------------|------------------------------------|
| <b>Sequence Order</b>  | <b>#1</b>  | <b>#2</b>    | <b>#3</b>       | <b>#4 / #12</b>             | <b>#13</b>                         |
|  | <b>Dual Echo SWI</b>                                     | <b>T2 WI</b> | <b>3D FLAIR</b> | <b>MPRAGE Pre/ Post Gad</b> | <b>3D VIBE Post Gad - Sagittal</b> |
| <b>Sequence</b>  | gre  | tse          | tse_vfl         | tfl                         | fl3d_vibe                          |
| Orientation  | Axial  | Axial        | Sagittal        | Axial                       | Sagittal                           |
| TR (ms)  | 29   | 7080         | 6000            | 1750                        | 3.97                               |
| TE (ms)  | 1 <sup>st</sup> TE = 6,<br>2 <sup>nd</sup> TE = 20       | 77           | 397             | 2.98                        | 1.43                               |
| TI (ms)  |  |              | 2200            | 900                         |                                    |
| FA (degree)  | 15   | 120          |                 | 9                           | 25                                 |
| FOV (mm <sup>2</sup> )                                       | 256x192  | 256x192      | 256x256         | 256x256                     | 352x275                            |
| Matrix size  | 512x256  | 512x256      | 256x256         | 512x256                     | 384x384                            |
| Nz/TH (mm)   | 128/2  | 100/2        | 160/1           | 192/1                       | 256/0.9                            |
| Voxel size (mm <sup>3</sup> )                                | 0.5x1x2  | 0.5x1x2      | 1x1x1           | 0.5x1x1                     | 0.9x0.9x0.9                        |
| Ave./Meas.   | 1  | 1            | 1               | 1                           | 1                                  |
| Phase oversmpl   |  |              |                 |                             |                                    |
| Slice oversmpl   |  |              |                 | 16.7%                       |                                    |
| Dist. factor   | 20%  | 0%           | 0%              | 50%                         | 20%                                |
| Phase Enc. Dir   | R>>L   | R>>L         | A>>P            | R>>L                        | A>>P                               |
| iPAT   | 2/24   | 2/24         | 2/24            | 2/24                        | 2/24                               |
| BW (Hz/pixel)  | 470 and 120  | 222          | 781             | 180                         | 690                                |
| Flow Comp  | Yes for 1 <sup>st</sup> TE,<br>No for 2 <sup>nd</sup> TE | No           | No              | No                          |                                    |
| Phase partial Fourier  | Off  | Off          | Allowed         | Off                         | 6/8                                |
| Slice partial Fourier  | Off  | Off          | 7/8             | Off                         | 6/8                                |
| Flow Mode/Direction  |  |              |                 |                             |                                    |
| Venc. (cm/s)   |  |              |                 |                             |                                    |
| 1 <sup>st</sup> Signal/Mode                                  |  |              |                 |                             |                                    |
| Echo spacing (ms)  |  | 11.1         | 3.32            | 7.6                         |                                    |
| Turbo factor   |  | 18           | 141             |                             |                                    |
| Echo trains per slice  |  | 6            | 1               |                             |                                    |
| Coils  | Head   | Head         | Head            | Head                        | Head                               |
| <b>Time</b>  | <b>06:39</b>   | <b>2:30</b>  | <b>5:20</b>     | <b>4:03x2</b>               | <b>1:45</b>                        |
| <b>Total Time</b>  | <b>06:39</b>   | <b>9:09</b>  | <b>14:29</b>    | <b>22:25</b>                | <b>24:10</b>                       |

**Note:**

- Position the subject at the orbital ridge.
- Slice position for the above sequences (Dual Echo SWI, T2, MPRAGE) should be true axial.
- If Dual Echo SWI is not possible at your center, run the sequence with a single echo TE = 20ms.
- 3D FLAIR and 3D VIBE POST GAD should be acquired in a sagittal plane.

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| <b>Neck (CSF / Jugulars) - with Contrast</b><br>(Center at the chin) |                      |                     |                                   |   |                                    |                                  |                                       |
|--|----------------------|---------------------|-----------------------------------|---|------------------------------------|----------------------------------|---------------------------------------|
| <b>Sequence Order</b>  | <b>#5</b>            | <b>#6</b>           | <b>#7</b>                         | <b>#8</b>   | <b>#9</b>                          | <b>#10</b>                       | <b>#11</b>                            |
|  | <b>2D MRV (neck)</b> | <b>T2 WI</b>        | <b>3D VIBE Pre Gad - Sagittal</b> | <b>3D MRV (Dynamic)</b><br><i>Inject Contrast after 3<sup>rd</sup> measurement for the 3D MRV</i> | <b>3D VIBE Post Gad - Sagittal</b> | <b>Flow Quantification (CSF)</b> | <b>Flow Quantification (Jugulars)</b> |
| <b>Sequence</b>  | fl_tof               | tse                 | fl3d_vibe                         | fl3d_ce   | fl3d_vibe                          | fl_fq_retro                      | fl_fq_retro                           |
| Orientation  | Axial                | Sagittal            | Sagittal                          | Coronal   | Sagittal                           | Axial                            | Axial                                 |
| TR (ms)  | 29                   | 2800                | 3.97                              | 3.31  | 3.97                               | 95.25                            | 95.25                                 |
| TE (ms)  | 5.02                 | 82                  | 1.43                              | 1.25  | 1.43                               | 10                               | 10                                    |
| FA (degree)  | 60                   | 160                 | 25                                | 20  | 25                                 | 20                               | 20                                    |
| FOV (mm <sup>2</sup> )   | 320x256              | 256x256             | 352x275                           | 340x255   | 352x275                            | 256x256                          | 256x256                               |
| Matrix size  | 512x256              | 384x268             | 384x384                           | 384x384   | 384x384                            | 448x448                          | 448x448                               |
| Nz/TH (mm)   | 128/3                | 19/3                | 256/0.9                           | 72/0.9  | 256/0.9                            | 1/2.5                            | 1/2.5                                 |
| Voxel size (mm <sup>3</sup> )  | 0.6x1.3x3            | 0.7x1x3             | 0.9x0.9x0.9                       | 0.9x0.9x0.9   | 0.9x0.9x0.9                        | 0.6x0.6x2.5                      | 0.6x0.6x2.5                           |
| Ave./Meas.   | 1                    | 1                   | 1                                 | 1/15  | 1                                  | 1                                | 1                                     |
| Phase oversmpl   |                      | 100%                |                                   |   |                                    |                                  |                                       |
| Slice oversmpl   |                      |                     |                                   | 11.1%   |                                    |                                  |                                       |
| Dist. factor   | -25.0%               | 0%                  | 20%                               | 20%   | 20%                                | 20%                              | 20%                                   |
| Phase Enc. Dir   | A>>P                 | H>>F                | A>>P                              | R>>L  | A>>P                               | A>>P                             | A>>P                                  |
| iPAT   | 2/24                 | None                | 2/24                              | PE: 2/48,<br>3D: 2/24   | 2/24                               | 2/24                             | 2/24                                  |
| BW (Hz/pixel)  | 217                  | 260                 | 690                               | 650   | 690                                | 192                              | 192                                   |
| Flow Comp  | Yes                  | Read                |                                   |   |                                    | No                               | No                                    |
| Phase partial Fourier  |                      | Allowed             | 6/8                               | 6/8   | 6/8                                |                                  |                                       |
| Slice partial Fourier  |                      |                     | 6/8                               | 6/8   | 6/8                                |                                  |                                       |
| Special Sat.   | Tracking F           |                     |                                   |   |                                    |                                  |                                       |
| Pre Saturation   | Gap 10mm;<br>TH 40mm |                     |                                   |   |                                    |                                  |                                       |
| Flow Mode / Direction  |                      |                     |                                   |   |                                    | Single Dir./<br>Through Plane    | Single Dir./<br>Through Plane         |
| Venc. (cm/s)   |                      |                     |                                   |   |                                    | 15                               | 50                                    |
| 1 <sup>st</sup> Signal/Mode  |                      |                     |                                   |   |                                    | Pulse/Retro                      | Pulse/Retro                           |
| Echo spacing (ms)  |                      | 10.3                |                                   |   |                                    |                                  |                                       |
| Turbo factor   |                      | 11                  |                                   |   |                                    |                                  |                                       |
| Echo trains per slice  |                      | 49                  |                                   |   |                                    |                                  |                                       |
| Coils  | Head+Nec<br>k+SP1,2  | Head+Neck<br>+SP1,2 | Head+Neck<br>+SP1,2               | Head+Neck<br>+SP1,2   | Head+Neck<br>+SP1,2                | Head+Neck+S<br>P1,2              | Head+Neck+S<br>P1,2                   |
| <b>Time</b>  | <b>6:57</b>          | <b>2:22</b>         | <b>1:45</b>                       | <b>2:52</b>   | <b>1:45</b>                        | <b>1:42</b>                      | <b>1:42(x3)</b>                       |
| <b>Total Time</b>  | <b>6:57</b>          | <b>9:19</b>         | <b>11:04</b>                      | <b>13:56</b>  | <b>15:41</b>                       | <b>17:23</b>                     | <b>22:29</b>                          |

**Note:**

- Position the subject to the chin for the neck. Make sure to use HEA;HEP;NE1,2;SP1,2 coils are highlighted.
- Please put a pulse trigger on the patient's index finger.
- Flow quantification will be done perpendicular to the CSF flow at C2/C3 neck level with a venc of 15cm/sec, and perpendicular to the internal jugular veins (IJV's) at the C2/C3, C5/C6 and T1/T2 neck levels with a venc of 50cm/sec.

**Now center at the brain to run the sequences #12 and #13 from page #1.**

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| <b>Azygus - with Contrast</b><br>(Center at the mid sternum) |                            |                                 |   |
|--|----------------------------|---------------------------------|---|
| <b>Sequence Order</b>  | <b>#14</b>                 | <b>#15</b>                      | <b>#16</b>                                  |
|  | <b>2D MRV<br/>(azygus)</b> | <b>2D MRV<br/>(azygus arch)</b> | <b>Flow<br/>Quantification<br/>(Azygus)</b> |
| <b>Sequence</b>  | fl_tof                     | fl_tof                          | fl_fq_retro                                 |
| Orientation  | Axial                      | Axial                           | Axial                                       |
| TR (ms)  | 41                         | 40                              | 95.25                                       |
| TE (ms)  | 5.02                       | 5.02                            | 10  |
| FA (degree)  | 60                         | 60                              | 20  |
| FOV (mm <sup>2</sup> )                                       | 256x256                    | 256x256                         | 256x256                                     |
| Matrix size  | 512x256                    | 512x256                         | 448x448                                     |
| Nz/TH (mm)   | 92/3                       | 46/3                            | 1/2.5                                       |
| Voxel size (mm <sup>3</sup> )                                | 0.5x1x3                    | 0.5x1x3                         | 0.6x0.6x2.5                                 |
| Ave./Meas.   | 1                          | 1                               | 1   |
| Phase oversmpl   | 20%                        | 20%                             |   |
| Slice oversmpl   |                            |                                 |   |
| Dist. factor   | -33.0%                     | -33.0%                          | 20%   |
| Phase Enc. Dir   | R>>L                       | R>>L                            | A>>P  |
| iPAT   | 2/24                       | 2/24                            | 2/24  |
| BW (Hz/pixel)  | 217                        | 217                             | 192   |
| Flow Comp  | Yes                        | Yes                             | No  |
| Sat Region 1   | 86 mm – Anterior           | 86 mm – Anterior                |   |
| Sat Region 2   |                            |                                 |   |
| Special Sat.   | Tracking H                 | Tracking F                      |   |
| Pre Saturation   | Gap10mm; TH 40mm           | Gap10mm; TH 40mm                |   |
| Flow Mode / Direction  |                            |                                 | Single Dir./ Through Plane                  |
| Venc. (cm/s)   |                            |                                 | 50  |
| 1 <sup>st</sup> Signal/Mode                                  |                            |                                 | Pulse/Retro                                 |
| Coils  | Neck +SP1,2,3,4            | Neck +SP1,2,3,4                 | Neck +SP1,2,3,4                             |
| <b>Time</b>  | <b>10:39</b>               | <b>5:12</b>                     | <b>1:42</b>                                 |
| <b>Total Time</b>  | <b>10:39</b>               | <b>15:51</b>                    | <b>17:33</b>                                |

**Note:**

- Position the subject center to the mid sternum. Make sure to use NE1,2;SP1,2,3,4 coils.
- Flow quantification will be done perpendicular to the azygus vein at the upper level. Please use venc of 50cm/s.