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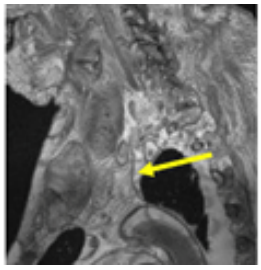
REVA #3: Magnetic Resonance Imaging (MRI) of Embalmed Cadaver



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Abstract

This protocol describes the procedures and parameters for magnetic resonance imaging (MRI) of embalmed human cadavers.

Guidelines

N/A

Materials

1. MRI-safe gurney
2. 3 T MRI Scanner (MAGNETOM Vida, Siemens Healthineers, Erlangen, Germany)
3. Transfer board (**Link**)
   a. Manufacturer: Allied Healthcare Products, sold on Medline. Name: XTRA Emergency Backboards.
4. MRI 20-channel head coil (Head/Neck 20 , Siemens Healthineers)
5. MRI 36-channel spine coil (Siemens Healthineers)
6. MRI 18-channel anterior body coils (x2) (Body Array, Siemens Healthineers)
7. Disinfectant wipes

Troubleshooting

Safety warnings

Personnel who will enter the MRI suite must be properly trained MR safety and approved by the local safety committee. Cadavers with significant metal implants (e.g., pacemakers, may not be optimal for this protocol due to potential image artifacts.

This protocol might include items and/or substances that may pose hazards (e.g., chemical, physical, biological, or otherwise) to your health upon use or exposure. Before engaging in the processes described in this protocol, familiarize yourself with and follow the safety data sheets, manufacturer safety recommendations, and local regulations.

Ethics statement

Be sure to seek approval for or an exemption from human subjects research from your local regulatory body(ies) as required by local and/or institutional regulations before initiating studies.

This study was determined to be exempt from IRB oversight by the Case Western Reserve University Institutional Review Board (IRB) because it involved de-identified cadaveric tissue and no protected health information was collected from the donors.

Before start

See the protocol for embalming and preparing a human cadaver for imaging (**dx.doi.org/10.17504/protocols.io.kxygx4wm4l8j/v1**), including placing it in a vacuum-sealed bag on a dissection cart for transport. On the day of the scan, before transporting the cadaver, ensure the vacuum seal bag is still tight and no air has entered the bag; if air has entered the vacuum seal bag, use an electric vacuum to remove it.

Section 1: Cadaver Placement in the MR Scanner

1 Move the cadaver (in a vacuum-sealed mattress bag) from the dissection cart used for transportation onto the MRI-safe gurney while outside the scan room. An MR-compatible patient transfer board can be used to facilitate transfer.

2 Place the cadaver on the MRI scanner table, positioning the head as far as possible inside of the head coil which should result in the shoulders coming in contact with the edge of the head coil.

3 The spine coil is already in place as it is built in with the table.

4 Place two (2) body coils over the chest and abdomen of the cadaver. Depending on the cadaver height, the rectangular coils can be placed with the longest edge in the left-right or head-foot direction as needed for coverage. Use straps to secure the coils to the table and minimize distance between coils and cadaver. The straps should also press the arms against the torso to minimize the required field of view during imaging. Coils should be abutted and there should be minimal overlap between coils. Ensure the cadaver is secured and that the arms are pressed against the torso.

5 Landmark the position of the cadaver using scanner controls using the nose as a point of reference.

Section 2: MRI Scan Session

6 Run a fast localizer scan spanning the entire volume to be imaged to visualize the general positioning of the cadaver. Reposition the cadaver as needed to straighten the spine and neck.

7 Run a higher resolution localizer, based on the HASTE sequence. Use the multi-station approach to ensure sufficient coverage from the top of the head to the pubic symphysis. Overlap each station by 15% to facilitate stitching of images from different stations into a single DICOM image with full coverage.

8 Run the Dixon-VIBE scan as defined in **Table 1**. Ensure inclusion of acromia for landmarking purposes.

	A	B	C	D
		CISS	**Dixon-VIBE**	**VIBE**

	A	B	C	D
	Orientation	Sagittal	Axial	Sagittal
	Minimum TR	5.99 ms	10.00 ms	10.00 ms
	TE	3.00 ms	Echo 1: 2.46 ms Echo 2: 3.69 ms	2.46 ms
	Flip angle	35 deg	10 deg	12 deg
	FOVx	256 mm	405 mm	323 mm
	FOVy*	256 mm	278 mm	212 mm
	FOVz*	224 mm	145.6 mm	128 mm
	Matrix (X, Y *)	512, 512	576, 396	640, 420
	Number of slices	448	208	256
	Oversampling in z	0.0%	15.4%	12.5%
	Oversampling in y	0.0%	10%	10%
	Elliptical scanning window	on	off	on
	Scan duration per station	35 min 57 sec	10 min 28 sec	14 min 23 sec
	Number of stations**	4	7	3
	Bandwidth	488 Hz/Px	430 Hz/Px	240 Hz/Px
	Averages	1	1	1
	Orientation	sagittal	axial	sagittal

	A	B	C	D
	Image resolution (acquired and reconstructed voxel size)* **	Acquired: 0.5 mm isotropic Reconstructed: 0.5 mm isotropic	Acquired: 0.7 mm isotropic Reconstructed: 0.7 mm isotropic	Acquired: 0.5 mm * 0.6 mm * 0.6 mm Reconstructed: 0.5 mm isotropic
	Dimensionality (2D vs 3D)	3D	3D	3D

Table 1. MRI scan parameters.

* Adapted for full anterior-posterior coverage dependent on body habitus; resolution is fixed at 0.5 mm.
** Adapted depending on the height of the subject.
*** 6/8 partial Fourier under sampling in both slice and phase for Dixon-VIBE

9 Run the CISS scan as defined in **Table 1**.

10 Run the VIBE scan as defined in **Table 1**. Ensure the number of stations and fields of view are exactly matched to CISS scan.

11 Stitch the images from sequential stations from scans in **Steps 8-10** into a single image using the vendor-provided stitching software.

12 Reformat all data (multiplanar reconstruction, MPR) to convert the sagittally acquired images into axial images.

13 Remove the cadaver from the scanner table to the MRI-compatible gurney using the transfer board.

14 Move the cadaver from the gurney to the dissection cart for removal from the MRI suite.

15 Use disinfectant wipes to clean the MR scanner table, control panels, and imaging coils.

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