Gadoxetate data acquisition protocols using a free-breathing dynamic 3D imaging sequence for Bruker ParaVision users

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Overview:
The following instructions are written for general use on Bruker ParaVision 6.0.1 and at 4.7T or 7T while using a single channel volume coil and anesthetized rats. Users will be able to download and execute a free-breathing dynamic 3D T1 mapping and DCE imaging sequences. Additional instructions with sequence screenshots are provided in the PowerPoint download. Sequences for download are provided on the TRISTAN IMI Downloads page.

Preparation:

1. Invoke ParaVision and import the following method using File-->Import-->Binary Method
    a. vFAIgFLASH
2. Invoke ParaVision and import the following datasets using File-->Import-->Datasets
    a. Sequences:
        i. T2_TurboRARE
        ii. vFAIgFLASH
        iii. Sequences for download on TRISTAN IMI Downloads page.
        iv. The sequences will be located under Scan Programs & Protocols/<your scanner's gradient type, for example "BGA12S2">/AnyObject/AnyRegion/UserMethods on scanner when imported
3. Store sequences in preferred location:
    a. Right click on the protocol(s) to be stored
        i. Select *Store Scan Protocol*
        ii. In the *Store Protocol* window that appears, enter Name/Object/Region/Application, e.g. T1map_RARE/Rat/Abdomen/Tristan_T1

4. Dilute contrast agent (Primovist, Bayer) 1:5 in saline, and prepare enough diluted agent to dose 0.5 mL/kg while accounting for the catheter line volume. Fill catheter line with heparinized saline (20 U/mL) leading up to contrast agent.

5. Use a single or dual channel volume transmit coil – preferably a rat body coil (~70mm id) if available in your centre

6. Weigh the animal. Induce anesthesia in an induction chamber using no more than 4.0% isoflurane in an approved air mixture, and once animal does not respond to toe pinch, insert a tail vein catheter under continued, lowered anesthesia from a nose cone (typically 1.5-3% isoflurane). Flush with small amount of heparinised saline (ca. 50ul)

7. Once animal is placed head first and prone on rat cradle, monitor respiratory rate and temperature using a respiratory pillow or bellows and rectal probe, respectively, and apply eye cream (eg. Peralube) to animal's eyes.
    a. Adjust isoflurane percentage to maintain stable level of anesthesia, typically using only 1.5-2.5% isoflurane such that respiration rate is between 40-80 bpm. Note down percentage of oxygen used.
    b. Circulate hot air into bore and/or warm water in animal cradle to maintain a stable body temperature near 37C. Use circulating warm water in cradle if no artifacts are present in images.
    c. Ensure respiratory pillow is placed caudal to liver.
    d. 1 cm of foam may be needed between rat and cradle in order to have the liver in the isocentre /to offset fixed slice dorsal-ventral location.

8. If desired, place a glass syringe or vial of saline on animal's back without distorting the anatomy. Ensure saline syringe will be in FOV as this will be used as a background drift reference, if needed.

9. Set up localizer and wobble for each first animal of the day. Check if the wobble is needed for the next animal, and adjust tune/match if applicable. Respiratory monitoring is recommended to ensure a respiratory rate of 50 – 80 breaths per minute.

10. Run site-preferred localizers to ensure the liver is at magnet isocenter. If not, reposition using a foam under the animal and
    a. Duplicate Localizer
    b. Set: All Setup + Acquisition in the Instruction Tab

11. Run vFAIgFLASH sequence – 1 min.
    a. On Routine Tab:
        i. Flip Angle Experiments=1
        ii. Flip Angle Array = 20
        iii. Repetitions=1

b. Ensure the following parameters are correct using the aforementioned PowerPoint presentation.
c. In the Instruction tab, ensure that Automatic Setup + Acquisition is selected for Scan Mode.
d. Update the respiratory rate in the Reconstruction tab.

12. If step #11 is positioned correctly and appears appropriate (can see vena cava clearly, no artifact, can see organs clearly) - 9.40 min
    a. duplicate step #11
    b. update respiratory rate if needed
    c. run with 10 repetitions with automatic adjustments

13. Run the T2_TurboRARE using the same slice orientation as step #11. Run with automatic adjustments. - 2.28 min

14. Run vFAIgFLASH sequence with all 13 flip angles and automatic adjustments. - 12.33 min.
    a. Duplicate series from step# 12, increase and edit the number of flip angles, and decrease the number of repetitions.
        i. FAs: 1:1:10, 15, 20, 30.
        ii. 1 repetition.
    b. Update respiratory rate as needed.

15. Duplicate vFAIgFLASH from step #12
    a. Update the respiratory rate in the Reconstruction tab.
    b. Set the number of repetitions to 30 in Routine tab
    c. In Instructions tab, use Prototype Mode and Individual Setup/Acquisition. Drag and drop GOP to left column.
    d. In setup card, manually enter the same RG from step #12.

16. BEFORE HITTING CONTINUE ON STEP 17:
    a. Ensure that MR-compatible infusion pump is ready for injection and loaded syringe prepared.
    b. Contrast bolus should be set to deliver over 30 seconds.
    c. Set timer for 4 min 45 sec

17. Begin new timer and dynamic IG FLASH at same time, and inject bolus of contrast agent at 4 min 45 sec into dynamic series. - 29 min.