Excretory MR pancreatography after intravenous administration of gadoteridol: preliminary results in eight healthy volunteers

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Aims and objectives

Gadolinium-based contrast material (GBCM) is slightly leaked to cerebrospinal fluid, salivary juice, and labyrinthine fluid several hours after intravenous administration [1-5]. Though, T1-wighted imaging cannot visualize these fluid contrast enhancements, heavily T2-weighted three-dimensional fluid-attenuated inversion recovery (hT2W-3D-FLAIR) imaging can visualize faint enhancement by low concentration GBCM [2-5].

Since the pancreas shares physiological and anatomical similarities with the salivary gland, we hypothesized that low concentration GBCM must be excreted from the pancreatic duct after intravenous administration, and hT2W-3D-FLAIR imaging can visualized the pancreatic duct by excreted contrast material.

The purpose of this preliminary study is to investigate the viability of excretory MR pancreatography using hT2W-3D-FLAIR after intravenous administration of GBCM.
Methods and materials

The medical ethics committee of our institution approved this study, and we obtained informed consent from all volunteers. Eight healthy volunteers (eight men; mean age, 38.6 years; range, 29-53 years) were enrolled in this study.

MR imaging

All MR imaging was performed on a 3-tesla MR unit (Skyra, Siemens, Erlangen, Germany) using a 32-channel body array coil. Volunteers underwent heavily T2-weighted three-dimensional MR pancreatography (usual MR pancreatography) for anatomical reference, and hT2W-3D-FLAIR for excretory MR pancreatography. Both images were obtained before and after intravenous GBCM administration (gadoteridol, 0.2 mL/kg). Scanning was performed five times at 1.5-hour intervals (at 0.5 hour, 1st scan; 2 hours, 2nd scan; 3.5 hours, 3rd scan; 5 hours, 4th scan; and 6.5 hours, 5th scan) after GBCM administration. Parameters for usual MR pancreatography and hT2W-3D-FLAIR employed identical FOV, matrix size, and slice thickness to facilitate comparison.

Detailed scan parameters of usual MR pancreatography were: variable flip angle 3D turbo spin echo technique (SPACE: sampling perfection with application-optimized contrasts by using different flip angle evolutions); repetition time (TR), 4900 ms; echo time (TE), 555 ms; frequency-selective fat-suppression pre-pulse; initial 180° refocusing flip angle rapidly decreased to 120° constant flip angle for the refocusing echo train; echo train length, 226; matrix size, 346 X 512; 12 oblique axial slice of 4 mm slice thickness; field of view (FOV), 253 X 300 mm; generalized autocalibrating partially parallel acquisition (GRAPPA) parallel imaging technique; acceleration factor of 3; number of excitations (NEX), 1.4, breath-hold, acquisition time 16sec.

Detailed scan parameter of hT2W-3D-FLAIR were: SPACE sequence; TR, 4900 ms; TE, 555 ms; inversion time, 1700 ms; frequency-selective fat-suppression pre-pulse; initial 180° refocusing flip angle rapidly decreased to 120° constant flip angle for the refocusing echo train; echo train length, 226; matrix size, 346 X 512; 12 oblique axial slice of 4 mm slice thickness; FOV, 253 X 300 mm; GRAPPA parallel imaging technique with acceleration factor of 3; number NEX, 1.4 breath-hold, acquisition time 16sec.

Image analysis

Two radiologists with 16 and 3 years' experience in abdominal MR imaging reviewed hT2W-3D-FLAIR images by referring to usual MR pancreatography in consensus. Visualization of the pancreatic duct was classified into 3 grade (visualized, slightly
visualized, or no visualized) at pancreatic head, body and tail. Then, one of the radiologists with 16 years’ experience examined the signal intensity of the pancreatic duct at pancreatic head, body and tail. If the pancreatic duct was detected on hT2W-3D-FLAIR images, circular regions of interests (ROIs) were manually drawn. If the pancreatic duct was not detected, circular ROIs were copied and pasted from the usual MR pancreatography to the hT2W-3D-FLAIR images on the same position. The signal intensity of the pancreatic parenchyma was also examined at pancreatic head, body and tail. And the mean signal intensity of the main pancreatic duct and pancreatic parenchyma was calculated.
Results

In all volunteers, pre-contrast-enhanced hT2W-3D-FLAIR images demonstrated no visualization of the pancreatic duct. Images of one volunteer were presented in Figure 1.

![Figure 1](image)

**Fig. 1:** A 53-year-old volunteer. (a) Usual MR pancreatography using hT2W-3D shows normal pancreatic duct (arrow). (b) hT2W-3D-FLAIR image of pre-contrast material administration shows no visualization of the main pancreatic duct. The main pancreatic duct (arrow) was well (c-e) and slightly (f) visualized after contrast material administration. (g) hT2W-3D-FLAIR image after 6.5 hours shows no visualization of the main pancreatic duct.

**References:** Radiology, Nagoya University Hospital - Nagoya/JP

After GBCM administration, the pancreatic duct was well or slightly visualized in 4 of 8 volunteers (50%) at first scan (0.5 hour), 7 volunteers (88%) at second scan (2 hours), 2 volunteers (25%) at third scan (3.5 hours), 2 volunteers (25%) at fourth scan (5 hours), and 2 volunteers (25%) at fifth scan (6.5 hours) (Table 1). The pancreatic duct
was visualized in all volunteers in at least one of the 5 scans. The visualization of the pancreatic duct was most frequently observed at the pancreatic body.

Table 1

<table>
<thead>
<tr>
<th>Visualization of the main pancreatic duct</th>
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<tbody>
<tr>
<td>Numbers of Volunteers</td>
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<tr>
<td>pre</td>
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<tr>
<td>Total</td>
</tr>
<tr>
<td>Pancreatic head</td>
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<td>Pancreatic body</td>
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<tr>
<td>Pancreatic tail</td>
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Table 1: Visualization of the main pancreatic duct

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The mean signal intensity of the pancreatic duct was 3.4 ± 0.7 (Standard deviation) at pre-contrast-enhancement, 8.0 ± 4.9 at first scan, 8.2 ± 4.5 at second scan, 4.7 ± 2.0 at third scan, 4.4 ± 1.6 at fourth scan, and 3.9 ± 0.9 at fifth scan (Table 2). And that of the pancreatic parenchyma was 2.8 ± 0.6 at pre-contrast-enhancement, 3.9 ± 1.0 at first scan, 3.1 ± 0.6 at second scan, 3.3 ± 0.6 at third scan, 3.1 ± 0.4 at fourth scan, and 3.3 ± 0.6 at fifth scan.
Table 2: Signal intensity of the main pancreatic duct and pancreatic parenchyma

References: Radiology, Nagoya University Hospital - Nagoya/JP
Fig. 1: A 53-year-old volunteer. (a) Usual MR pancreatography using hT2W-3D shows normal pancreatic duct (arrow). (b) hT2W-3D-FLAIR image of pre-contrast material administration shows no visualization of the main pancreatic duct. The main pancreatic duct (arrow) was well (c-e) and slightly (f) visualized after contrast material administration. (g) hT2W-3D-FLAIR image after 6.5 hours shows no visualization of the main pancreatic duct.

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Table 1: Visualization of the main pancreatic duct

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Table 2: Signal intensity of the main pancreatic duct and pancreatic parenchyma

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Conclusion

The scan timing and parameter may not be enough for optimal visualization of the pancreatic duct. And the association between the pancreatic function and the degree of visualization of the pancreatic duct is also unknown yet. However, this study demonstrated that hT2W-3D-FLAIR could visualize contrast enhancement of the pancreatic duct after intravenous GBCM administration. Therefore, hT2W-3D-FLAIR images after intravenous GBCM administration may be used as excretory pancreatography.
References


