# Assessment of Vascular Malformations in the Head and Neck with Two-Dimensional MR Digital Subtraction Angiography (2D MRDSA)

**Toshiyuki OKUBO**[1], Takeharu YOSHIKAWA[2], Masaaki HORI[3], Keiichi ISHIGAME[4], Shigeki AOKI[5], Osamu ABE[6], Tsutomu ARAKI[7], Kuni OHTOMO[5]

[1]Yamanashi Medical University, Nakakoma-gun, Yamanashi Japan; [2]Tokyo University, Hongo., Tokyo Japan; [3]Yamanashi Medical Univeristy, Department of Radiology, Nakakoma-gun, Yamanashi, Japan; [4]Yamanashi Medical School, Nakakoma-gun, Yamanashi Japan; [5]University of Tokyo, Department of Radiology, Faculty of Medicine, Tokyo, Japan; [6]Faculty of Medicine, Radiology, Tokyo, Japan; [7]Yamanashi Medical University, Department of Radiology, School of Medicine, Nakakoma-gun, Yamanashi Japan

## Introduction

It is important to estimate the degree of vascularity and arteriovenous shunt in soft-tissue vascular malformations, because treatment method depends on hemodynamics of the lesions.

The purpose of this study was to evaluate the usefulness of two-dimensional thick-slice magnetic resonance digital subtraction angiography (2D MRDSA) technique in the assessment of vascular malformations in the head and neck.

## Methods

Twenty-four clinically diagnosed vascular malformations underwent contrast-enhanced 2D MRDSA. 2D MRDSA was performed by fast spoiled gradient echo sequence (TR=5.8ms, TE=1.3ms, flip angle=20-40, FOV=24-38cm, matrix=512x 192, slice thickness=50-100mm). Each image was taken within one second, and a set of 60-120 images was obtained during intravenous bolus administration of gadolinium chelates. The typical injection rate was 10ml/s with total amount of 15ml. The pre-contrast image was used as a mask to produce subtraction angiograms.

Ten lesions were subsequently examined by intraarterial digital subtraction angiography (IADSA), and were treated with percutaneous sclerotherapy with or without arterial embolization.

## Results

The twenty-four lesions were subdivided into two groups by 2D MRDSA findings; high-flow group (including arteriovenous malformation) which showed arterial dilatation, early venous filling, or prominent abnormal blood pooling, and low-flow group (including venous and lymphatic malformation, embolized arteriovenous malformation) which only showed faint abnormal blood pooling.

The high-flow group consisted of ten lesions and the low-flow group, fourteen ones. This result correlated well with clinical and other radiological findings.

In six high-flow lesions compared with IADSA, good correlation was achieved in the visualization of early venous filling and abnormal blood pooling (Table 1) (Fig.1).

In three of four low-flow lesions, 2D MRDSA was superior to IADSA in the visualization of abnormal blood pooling (Table 2).

High-flow lesions were treated with combination of percutaneous sclerotherapy and arterial embolization, and low-flow lesions were treated with sclerotherapy only.

**Table 1.** Comparison between visualization of high-flow group lesions on MRDSA and that on IADSA

| | MRDSA | IADSA |
|---|---|---|
| Arterial dilatation | 4/6 | 6/6 |
| Early venous filling | 4/6 | 4/6 |
| Prominent blood pooling | 4/6 | 4/6 |

**Table 2.** Comparison between abnormal blood pooling of low-flow group lesions on MRDSA and that on IADSA

| Abnormal blood pooling | MRDSA | IADSA |
|---|---|---|
| Faint | 0/4 | 2/4 |
| Moderate | 3/4 | 2/4 |
| Definite | 1/4 | 0/4 |

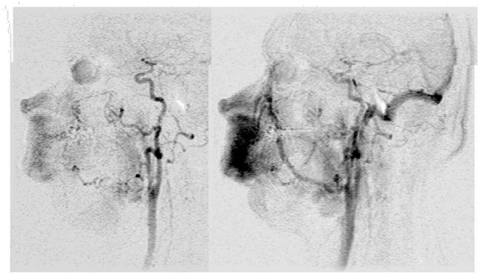

**Fig. 1** High-flow VM of 33-year-old man. MRDSA ( sagittal section of 70mm thickness on the right side) demonstrates dilatation of facial artery and internal maxillary artery with early venous filling and prominent blood pooling.

## Discussion

Our 2D MRDSA with high temporal resolution uniquely demonstrated head and neck hemodynamics like X-ray angiography. Making use of cine mode display on a workstation, it was easy to grasp hemodynamics in the head and neck. Also, the image interpretation of MRDSA is similar to conventional angiography, which has been a very familiar tool for radiologists.

Administration of Gadolinium-chelates is essential in order to evaluate vascular malformations in the head and neck MR examinations. Obtaining MRDSA images costs only a short amount of time with minor post-processing when a contrast media is given anyway. Thus MRDSA offers additional information about hemodynamics with little cost and risk. To the contrary, although IADSA provides more precise hemodynamic information, it is rather invasive and needs more expense, time and labor. Therefore MRDSA has an important advantage and a potential to obviate some IADSA examinations.

2D MRDSA has disadvantage in spatial resolution, because high temporal resolution of 2D thick-slice MRDSA is obtained by trading off 3D information. However, temporal resolution of 3D techniques is not high enough to discriminate between arterial phase and venous phase in the head and neck, because circulation time within high-flow vascular malformation is very short. Furthermore, 3D technique requires a high performance imager and additional software which are not widely available. When trading off 3D information, 2D acquisition must be superior to 3D acquisition in temporal resolution. 2D MRDSA has a simple sequence design without a high gradient performance. Therefore, we believe that 2D MRDSA is more widely prevailed.

In conclusion, 2D MRDSA has enough temporal resolution and is useful non-invasive method to estimate hemodynamics of vascular lesions. This method can be used for pre-treatment and follow-up evaluation of vascular malformations in the head and neck.

## References

1. Prince MR. Gadolinium-enhanced MR aortography. Radiology 91: 155-164, 1994

2.Aoki S, Yoshikawa T, Hori M, Nanbu A, Kumagai H, Nishiyama Y, Nukui H, Araki T. MR digital subtraction angiography for the assessment of cranial arteriovenous malformations and fistulas. AJR Am J Roentgenol. 175(2):451-3, 2000

3.Yoshikawa T, Aoki S, Hori M, Nanbu A, Kumagai H, Araki T. Time-Resolved Two-Dimensional Thick-Slice Magnetic Resonance Digital Subtraction Angiography (MRDSA) in Assessing Brain Tumors European Radiology 10:736-744, 2000

4.Baker LL., Dillon WP., Hieshima GB., Dowd CF., Frieden IJ. Hemangiomas and vascular malformations of the head and neck: MR characterization. AJNR American Journal of Neuroradiology. 14(2):307-14, 1993