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Imaging

3-Dimensional rotational angiography for the treatment of spinal cord vascular malformations

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Abstract

Background: This study was conducted to evaluate the effect of 3D-RA on the treatment of SCVMs.

Methods: Twelve patients with SCVM were retrospectively reviewed for details of 2D and 3D-RA findings. Pretherapeutic 2D and 3D-RA angiograms were compared with respect to 4 critical categories of parameters: (1) the exact anatomic location, size, and extent; (2) the definitive diagnosis; (3) the precise angioarchitectural configuration; and (4) the contribution to further intervention.

Results: Overall, 2D and 3D-RA were equally effective in demonstrating the exact anatomic location, size, and extent, and establishing the definitive diagnosis of SCVM in all 12 cases. 3-Dimensional rotational angiography demonstrated precise angioarchitectural configuration in 8 (8/12) cases, facilitated treatment in 6 (6/12) cases, and modified therapeutic strategies in 2 (2/12) cases via information not available from 2D-DSA images. Both 2D and 3D-RA contributed equally to the therapeutic intervention in 4 (4/12) patients. No complications occurred as a result of 3D-RA.

Conclusions: 3-Dimensional rotational angiography may enhance our ability to treat SCVMs with complex angioarchitecture and is an ideal addition to conventional 2D angiography in the management of these vascular lesions.

Keywords: Three-dimensional rotational angiography; Angioarchitecture; Treatment; Spinal vascular malformation

1. Introduction

Spinal cord vascular malformations represent a unique group of complex vascular abnormalities that can cause serious neurologic deficit by hemorrhage, by venous hypertension, by arterial steal, or by extensive thrombosis of the spinal venous drainage system [4,11]. To guide the best and safe therapy for SCVMs, accurate radiologic assessment is mandatory. For years, conventional 2D angiography has been considered the “gold standard” in making definitive diagnosis [2]. In some instances, however, it is not adequate to demonstrate all key angiographic features because of the limited number of projections [8]. Considering the superiority of 3D angiography in demonstrating anatomic features of vasculatures, we consecutively applied 3D-RA to 12 patients with SCVM. In this work, we describe the useful findings of 3D-RA for SCVM treatment.

2. Patients and methods

We retrospectively investigated the effect of 3D-RA in consecutive patients who underwent 2D DSA and 3D-RA on the treatment of SCVMs at our institution between

Abbreviations: 2D, 2-dimensional; 3D-RA, 3-dimensional rotational angiography; AVF, arteriovenous fistula; AVM, arteriovenous malformation; CTA, computed tomographic angiography; DSA, digital subtraction angiography; MRA, magnetic resonance angiography; SCVM, spinal cord vascular malformation; SDAVF, spinal dural AVF.

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Table 1
Summary of patients

Patient no.	Age (y)/sex	Diagnosis	SCVM site	Classification[a]	Additional benefits of 3D-RA over 2D-DSA
1	30/F	Conus AVM	Conus medullaris	AVM; conus[b]	Delineating optional vascular access; embolization facilitated
2	15/M	Cobb syndrome	T9-T10	AVM; extradural-intradural[b]	Predicting the potential complication; embolization modified
3	44/M	SDAVF	T12	AVF; intradural; dorsal; single feeder	–[c]
4	33/M	Intramedullary AVM	T11-T12	AVM; intradural[b]	Confirming the aneurysm; embolization facilitated
5	59/M	Perimedullary AVF	L1-L2	AVF; intradural; ventral; small shunt	–[c]
6	52/M	Perimedullary AVF	T10-T11	AVF; intradural; ventral; medium shunt[b]	Indicating the location of shunt; embolization facilitated
7	42/M	Perimedullary AVF	T12-L1	AVF; intradural; ventral; medium shunt[b]	Indicating the location of shunt; embolization facilitated
8	61/M	Hemoangioblastoma	Cervicomedullary junction	Neoplastic vascular malformation[b]	Predicting the potential complication; surgery modified
9	37/M	Intramedullary AVM	T2-T4	AVM; intradural[b]	Demonstrating critical anatomic features; embolization facilitated
10	60/F	SDAVF	L1	AVF; intradural; ventral; single feeder[b]	Indicating the location of shunt; surgery facilitated
11	59/M	SDAVF	T9	AVF; intradural; dorsal; single feeder	–[c]
12	63/M	SDAVF	L4	AVF; intradural; dorsal; single feeder	–[c]

[a] From Spetzler et al [13].
[b] Lesion with complex angioarchitectural features, including intricate hemodynamic change, arterial feeding, venous draining pattern, and shunt difficult to identify, etc.
[c] Both 3D-RA and 2D-DSA contribute equally to the treatment of SCVMs.

January 2005 and September 2006. A total of 12 patients (10 men and 2 women; mean age, 46.2 years; range, 15-63 years) were included. Table 1 provides summary of patient characteristics and lesions. Informed consent was obtained and DSA images were acquired, as approved by the hospital and university ethics review board.

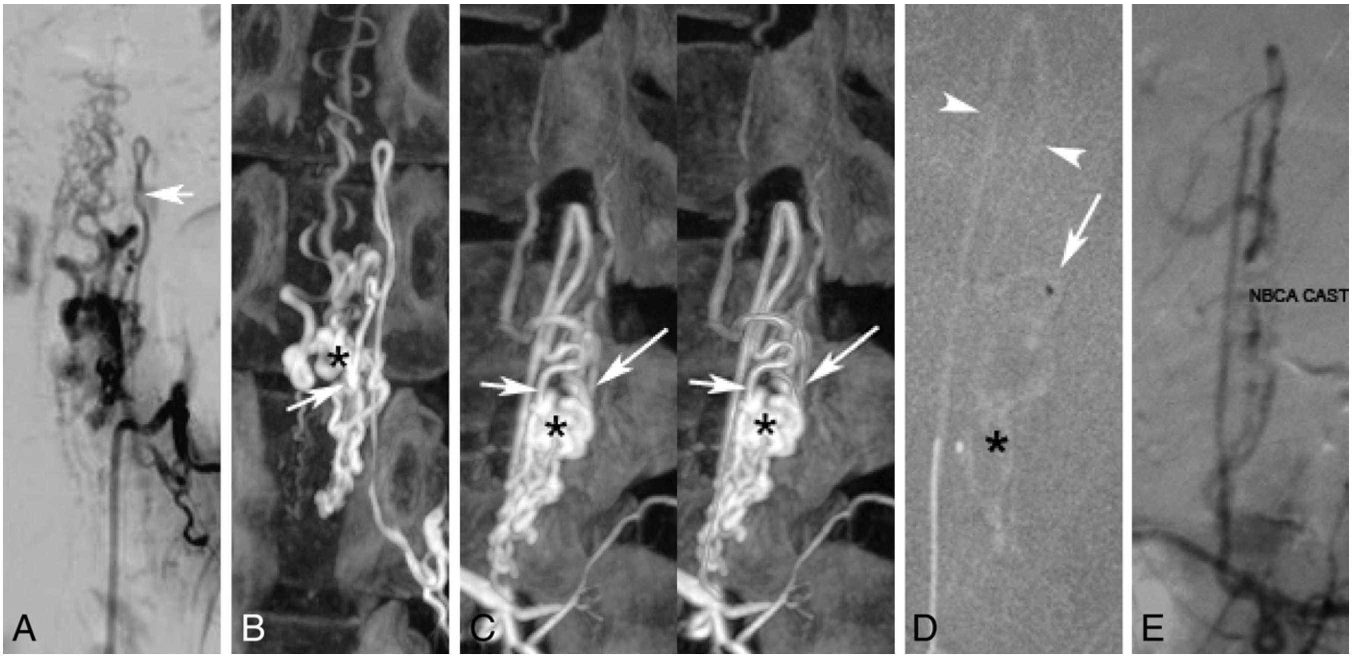

Fig. 1. (Patient 1, Table 1). A 30-year-old woman complained of progressive paraparesis followed by sphincter dysfunction. A: 2D angiogram of left L2 lumbar artery shows the posterior spinal artery (arrow) filling a conus AVM with complex angioarchitecture. B, C: 3D-RA image clearly demonstrates the location of shunt and establishes an optimal working angle and vascular access. Note the location of shunt (short arrow), nidus (asterisk), feeding artery (outlined in red), nidal-venous junction (long arrow), and ascending venous drainage (outlined in blue). D: Target embolization; note the microcatheter advanced to the level of shunt with the use of working angle and vascular access (arrowheads). E: Postembolization angiogram demonstrates the diminished shunt. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)