Magnetic Resonance Venography in Intracranial Veno-occlusive Disease

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Objective: *To identify the common MRV findings in the patient diagnosed intracranial veno-occlusive disease at Ramathibodi Hospital and to identify the underlying conditions that probably predisposed the patient to the intracranial veno-occlusive disease.*

Material and Method: *Sixty-four patients with clinically suggestive intracranial veno-occlusive disease who underwent MRV were reviewed in terms of signs and symptoms, MRV methods, MRV findings, and clinical diagnosis after report MRV. In cases diagnosed to have intracranial veno-occlusive disease, the patients' records were reviewed to identify predisposing conditions.*

Results: *Thirty-four patients were diagnosed to have intracranial veno-occlusive disease. The common findings were lack of typical high flow signal from a sinus that did not appear aplastic or hypoplastic, frayed appearance of flow signal from a sinus at a later stage of the thrombus, and collateral vessels and cerebral hemorrhage. The common sites were superior sagittal sinus, and left and right transverse sinuses. Hypoplasia, a normal variation, was incidentally found in eight patients (12.5%). The most common hypoplastic site was the left transverse sinus. Contributing factors in patients diagnosed to have intracranial veno-occlusive disease in the present series were birth control pill in take, tumor (meningioma, and malignant schwannoma of the scalp), blood dyscrasia, AVM, hypotension, and abscess. The causes of intracranial venous thrombosis could not be identified in seven patients (21%).*

Conclusion: *The common MRV finding in acute intracranial veno-occlusive disease was lack of typical high flow signal from a sinus while frayed appearance of flow signal from a sinus was the common direct sign in chronic condition. In the present series, birth control pill intake was the most common contributing factor.*

Keywords: *Intracranial venoocclusive disease, Magnetic resonance venography*

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Intracranial veno-occlusive disease is an elusive, often under diagnosed cause of acute neurological deterioration. Because clinical signs and symptoms are often non specific, radiological imaging is critical for diagnosis of this disorder. Intracranial veno-occlusive disease can be divided into two categories, venous stenosis, and venous thrombosis. Intracranial venous stenosis is narrowing of lumen by extrinsic force and may result from an adjacent tumor etc. Intracranial venous thrombosis is partial or complete reduction in vascular lumen by intraluminal clot and may result from contiguous infection, trauma, venous stasis, hypercoagulable state (birth control pills, pregnancy, and puerperium), increased blood viscosity as in polycythemia and dehydration, or collagen vascular disease such as systemic lupus erythematosus. The causes of intracranial venous thrombosis cannot be identified in one quarter of all cases[1,2]. Headache represents the most common symptom, occurring in approximately 75% of cases. Other common features include papilledema (40-50%), hemiplegia and seizures (33%), and depressed levels of consciousness (25%)[3,4].

Cerebral angiography, computed tomography, and magnetic resonance imaging (MRI) including MR venography (MRV) can diagnose intracranial veno-

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occlusive disease. The use of cerebral MRV is increasing in frequency as a noninvasive mean in evaluating the intracranial venous system[5]. Because of their sensitivity to slow flow, 2D time-of-flight (2D TOF) and 2D phase contrast (2D PC) sequences are frequently used for evaluation of the cerebral venous circulation[1,7,8,9].

The purpose of the present study was to identify the common MRV findings in the patient diagnosed intracranial veno-occlusive disease at Ramathibodi Hospital and to identify the underlying conditions that probably predisposed the patient to the intracranial veno-occlusive disease.

Material and Method

In retrospective review for 5 years (January 1996 to December 2000), 70 patients with clinically suggestive of intracranial veno-occlusive disease were reviewed by computerized searching from our report data. Five patients with no available clinical record and one patient with no available imaging data were excluded from the present study. Sixty-four patients with clinically suggestive of intracranial veno-occlusive disease with an available record were reviewed in terms of signs and symptoms, MRV methods, MRV findings, and clinical diagnosis after report of the MRV. All MRV's were performed by using 1.5 Tesla superconductive magnet (1.5 Signa, General Electric Medicals, Milwaukee, USA) using two dimensional time of flight technique (2D TOF) (with or without intravenous contrast enhancement), two-dimensional phase contrast technique (2D PC), three-dimensional phase contrast technique (3D PC) or combination of these techniques. To diagnose intracranial venous thrombosis, both direct and indirect signs were looked for. Direct sign of intracranial venous thrombosis on MRV included lack of typical high flow signal from a sinus that did not appear aplastic or hypoplastic on a single section from the MRV. Another direct sign was the frayed appearance of the flow signal from a sinus at a later stage (after recanalization) of the thrombus. Indirect signs of intracranial venous thrombosis included evidence of formation of collateral over extracranial vessels, unusually prominent flow signal from deeper medullary vein, cerebral hemorrhage, visualization of emissary veins, and sign of increased intracranial pressure. In cases diagnosed to have intracranial veno-occlusive disease, the patients' records were reviewed to identify predisposing conditions.

Results

Sixty-four patients with clinical findings suggestive of intracranial veno-occlusive diseases were reviewed. There were 45 women and 19 men, age ranging from 4 months to 73 years (mean age, 37.9 years).

The symptomatic periods were not recorded in three patients, the other four were sent for evaluation of the venous involvement of the tumor. The symptomatic periods of the rest (57 cases) varied from 1 day to 2 years (median 7 days).

There are four techniques used in the present study, detailed in Table 1.

In the interpretation of the magnetic resonance venography (MRV) of all 64 patients, 30 patients were diagnosed not to have intracranial veno-occlusive diseases. Intracranial veno-occlusive diseases could be ruled out on the basis of an evident high flow signal seen in all major portions of the sinus system and unremarkable flow signal from deep subcortical veins. The three most common finally clinical diagnosis were encephalitis (n = 4, 15%), arterial infarction (n = 4, 15%) and pseudotumor cerebri (n = 3, 11%).

Table 1. Magnetic resonance venography techniques

Technique	Number	%
Two dimensional time of flight technique (2DTOF)		
- Without intravenous contrast enhancement	56	88
- With intravenous contrast enhancement	27	42
Phase contrast technique (PC)		
- Two dimensional PC	45	70
- Three dimensional PC	8	13

Remark: Some patients were examined with more than one technique

Table 2. MRV findings

MRV findings	Number	%
- Lack of typical flow signal from a sinus that did not appear aplastic or hypoplastic (Thrombus)	15	44
- Frayed appearance of flow signal from a sinus at a later stage of the thrombus	14	41
- Collateral over extracranial vessels	13	38
- Cerebral hemorrhage	13	38
- Narrowing of the lumen (Stenosis)	12	35

The remaining 34 patients were diagnosed to have intracranial veno-occlusive diseases. The MRV findings are shown in the Table 2.

The involved sites were shown in Table 3.

The underlying conditions that probably predisposed the patient to the intracranial veno-occlusive diseases were reviewed from the patient's records and are shown in Table 4.

Incidentally, the venous hypoplasia was the normal variation recognized in eight patients out of 64 (12.5%). Examination of the single sections from the MR angiographic sequence allowed differentiating of hypoplasia from thrombosis. The hypoplastic sites are detailed in Table 5.

Table 3. Site of intracranial venoocclusive diseases

Site	Number	%
Superior sagittal sinus	30	83
Left transverse sinus	21	58
Right transverse sinus	18	50
Left sigmoid sinus	9	25
Right sigmoid sinus	8	22

Table 4. Underlying conditions that probably predisposed the patient to the intracranial venoocclusive diseases

Underlying Conditions	Number	%
Birth control pill intake	10	29
Tumor		
- Meningioma (occipital lobe 4 cases, parietal lobe 2 cases)	6	18
- Malignant schwannoma of the scalp	1	3
Blood dyscrasia		
- Protein C deficiency	2	6
- Protein S deficiency	1	3
- Polycythemia vera	1	3
AVM at left cerebellum	2	6
Miscellaneous (i.e. hypotension, brain swelling, trauma, abscess)	4	12
Unknown causes	7	21

Table 5. Sites of venous sinus hypoplasia

Sites	Number	%
Left transverse sinus	7	87.5
Left sigmoid sinus	2	25.0
Left jugular vein	2	25.0
Right transverse sinus	1	12.5
Right sigmoid sinus	1	12.5
Right jugular vein	1	12.5

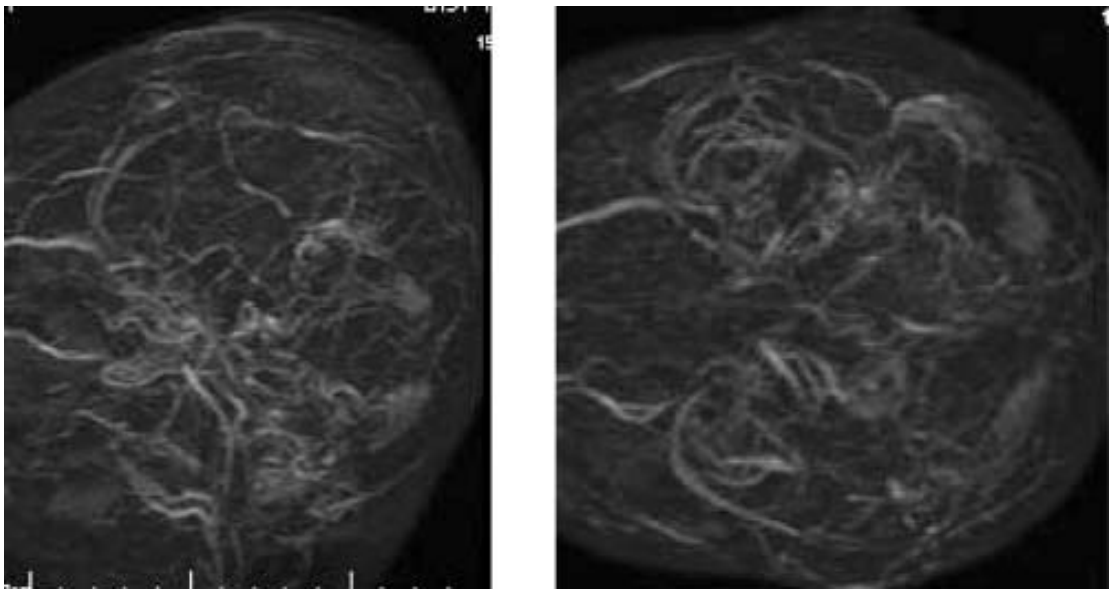
remark: Some patients did have hypoplasia in more than one site

Discussion

For intracranial venous thrombosis, direct sign on MRV included lack of typical high flow signal from a sinus that did not appear aplastic or hypoplastic on single section from MRV. Another direct sign was the frayed appearance of the flow signal from a sinus at a later stage (after recanalization) of the thrombus. Indirect signs of intracranial venous thrombosis included evidence of formation of collaterals over extracranial vessels, unusually prominent flow signal from deeper medullary vein, cerebral hemorrhage, visualization of emissary veins, and signs of increased intracranial pressure[10,11].

Concerning the techniques, 2D coronal time-of-flight technique was used in most of the cases because of good signal uniformity along the length of the vessel, sensitivity to slow flow, availability to retrospectively produce projection images at arbitrary angles, and relatively short duration of acquisition time. However, TOF images suffer from a problem with saturation of tortuous and slow flow and sometimes poor background suppression, which degrades vessel conspicuity. When it is necessary, the authors should use PC technique that is ideal for differentiating between blood flow and thrombus, and give excellent background suppression.

In the present study, lack of flow void with intraluminal thrombus, which was often considered being a sign of thrombosis was recognized in 15 patients (44%). The potential pitfall was the loss of signal that can be seen in areas of flow that were course parallel to the measuring plane for a given distance from coronal 2D TOF images. To avoid this pitfall, one could obtain a sagittal or axial image. Finding of the vigorous flow signal seen proximal and distal to these regions was generally sufficient to rule out thrombosis. Furthermore, examination of the individual sections of the MRV usually revealed clearly the flow in this region. To differentiate the hypoplasia from thrombosis, examination of single frames from 2D TOF was useful. Because in all the cases of thrombosis, the true lumen could be discerned as being partly or completely filled with material of low to intermediate signal intensity, which never attained the high intensity of flow signal.



A B

Fig. 1 A 19-year-old woman was presented with headache and vomiting for 5 days. The physical examination revealed no localizing signs, she had been on birth control pills
A and B: The 2D TOF MRV study in sagittal view (A) and axial view (B) revealed absent flow signal in the superior sagittal sinus, left basal vein of Rosenthal, internal cerebral vein, vein of Galen, straight sinus, bilateral transverse sinuses, sigmoid sinuses, and jugular bulb, compatible with extensive intracranial venoocclusive disease

The MR findings of the presence of intraluminal strands were seen in 14 patients (41%). This finding could be seen within 2 weeks from onset of symptoms and still plainly evident after months of freedom from symptoms. This is a direct sign that indicates flow signal from a sinus at a later stage (after recanalization). A further advantage of MRV and spin echo imaging is the ability to simultaneously show certain concomitant changes in the brain parenchyma. The intracranial veno-occlusive disease is frequently accompanied by venous infarct and intracranial hemorrhage, this can play a role in therapeutic decision-making. Depending on the severity of signs and symptoms and the extent of infarct or hemorrhage, the decision to commence heparin therapy may be based on the extent of these collateral phenomena.

In conclusion, the common MRV findings in the patients diagnosed with intracranial veno-occlusive disease at Ramathibodi Hospital is lack of typical high flow signal from a sinus, intralumnial thrombus that did not appear aplastic or hypoplasia. The common finding in chronic condition is frayed appearance of flow signal from a sinus after recanalization. The common indirect signs were cerebral hemorrhage and collateral vessel formation. In the present series, birth control pill intake was the most common contributing factor.

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การตรวจวินิจฉัยภาวะหลอดเลือดดำในสมองอุดตันโดยการตรวจคลื่นแม่เหล็กไฟฟ้า

พามดา สุวรรณพานิช, จิรพร เหล่าธรรมทัศน์

ภาวะหลอดเลือดดำในสมองอุดตัน มีอาการและอาการแสดงที่ไม่จำเพาะเจาะจง ทำให้ยากต่อการวินิจฉัย การตรวจทางรังสีโดยเฉพาะอย่างยิ่งการตรวจหลอดเลือดดำในสมองโดยการตรวจคลื่นแม่เหล็กไฟฟ้า (Magnetic Resonance Venography) จึงเข้ามามีบทบาทสำคัญ การศึกษานี้จึงจัดทำเพื่อศึกษาลักษณะภาพทางรังสีและปัจจัยเสี่ยงที่พบได้บ่อยในผู้ป่วยที่มีภาวะหลอดเลือดดำในสมองอุดตัน โดยศึกษาย้อนหลังในผู้ป่วย 64 รายที่มีอาการและอาการแสดงทางคลินิกบ่งชี้ว่าน่าจะมีภาวะหลอดเลือดดำในสมองอุดตันและได้รับการตรวจคลื่นแม่เหล็กไฟฟ้า และรวบรวมข้อมูลทางด้านอาการ อาการแสดง เทคนิคการตรวจหลอดเลือดดำในสมองโดยการตรวจคลื่นแม่เหล็กไฟฟ้า ลักษณะภาพทางรังสีที่พบ อีกทั้งรวบรวมปัจจัยเสี่ยงในผู้ป่วยที่ได้รับการวินิจฉัยว่ามีภาวะหลอดเลือดดำในสมองอุดตัน พบว่ามีผู้ป่วย 34 รายได้รับการวินิจฉัยว่ามีภาวะหลอดเลือดดำในสมองอุดตัน โดยลักษณะภาพทางรังสีที่พบได้บ่อยที่สุดคือการไม่เห็นสัญญาณคลื่นแม่เหล็กไฟฟ้าในตำแหน่งที่มีการอุดตันของหลอดเลือดดำ ตำแหน่งหลอดเลือดดำที่พบอุดตันมากที่สุด คือ Superior sagittal sinus และปัจจัยเสี่ยงที่พบบ่อยที่สุด คือ การรับประทานยาคุมกำเนิด