Original Research Article

Evaluation of cerebral venous sinus thrombosis as a prognostic profile with MR imaging

Sandeep Nandamuri[1], Y S Arun Kumar Reddy[2*]

[1]Consultant Radiologist, Star Hospitals, Hyderabad, Telangana, INDIA.
[2]Associate Professor, Department of Radio Diagnosis, Mamata Academy of Medical Sciences, Bachupally, Hyderabad, INDIA.
Email: nageshmsc@gmail.com

Abstract

Background: Cerebral venous thrombosis (CVT) is a cause of stroke with inconspicuous pathophysiological properties that differ from an arterial stroke. It is an elusive diagnosis because of its non-specific presentation and its subtle imaging findings. Diagnosis is often missed on initial imaging. **Aims and Objective:** To compare cerebral parenchymal changes and sinuses involvement in CT with MRI and MRV in Cerebral Venous Thrombosis patients. **Materials and Method:** This study was conducted mainly in the Department of Radio diagnosis, Mamata Academy of Medical Sciences, Bachupally, from January 2019 to November 2019 and includes fifty-five patients from all age groups exhibiting the clinical symptoms of CVT, admitted in Medicine, Paediatric, Neurosurgery, Neurology wards. CT, MRI and MRV findings were noted, and statistical analysis was done using SPSS software. **Result:** Out of fifty cases of cerebral venous thrombosis, thirty-one were females, and nineteen were males. Age range was new-born to seventy-one years with female predominance at a young age the majority of the patients presented with headache (78%) followed by seizures (32%). CT scan was able to diagnose sinus abnormality in 36% and parenchymal abnormality in 42% of cases as compared to 100% and 52% in MRI. **Conclusion:** In the emergency setting CT scan plays an important role in evaluating patients clinically suspected CVT, whereas MRI combines with MR Venography is the best imaging technique for diagnosis of CVT in patients with equivocal findings on CT.

Key Words: Cerebral Venous Sinus Thrombosis, cerebral venous thrombosis, MRI and MRV

***Address for Correspondence:**
Dr Y S Arun Kumar Reddy, Associate Professor, Department of Radio Diagnosis, Mamata Academy of Medical Sciences, Bachupally, Hyderabad, INDIA.
Email: nageshmsc@gmail.com

Received Date: 05/05/2020 Revised Date: 19/06/2020 Accepted Date: 09/07/2020
DOI: https://doi.org/10.26611/10151523

Access this article online	
Quick Response Code:	Website: www.medpulse.in
	Accessed Date: 20 August 2020

INTRODUCTION

Acute stroke is one of the significant causes of morbidity and fatality. It can be both, i.e. arterial or venous in origin. Venous infarction, compared to arterial stroke, is not common, potentially treatable and so has a good prognosis. Cerebral venous thrombosis is not an unfamiliar disease. The exhibiting signs and symptoms of cerebral venous sinus thrombosis are so vague and diverse that it is referred to as `The Great Masquerade of diseases[1]. Cerebral venous thrombosis is a somewhat severe but uncommon neurologic disorder that is potentially reversible with prompt diagnosis and appropriate medical care. Because of the possible unusual factors and clinical manifestations of this disorder are multiple and varied, radiological imaging plays a primary role in the diagnosis. Whenever clinically suspected, the prompt investigation by non-invasive imaging Magnetic resonance (MR) or advanced modalities such as MRV (MR Venography) will help in prompt and accurate detection, diagnosis and treatment[2]. Cerebral venous thrombosis (CVT) is accountable for 1-2% of all strokes in adults and affects all age groups. Estimated annual prevalence is 3-4 cases per million people and a fatality rate of 8 %. Prompt and accurate diagnosis of cerebral venous thrombosis is vital because timely and suitable therapy can reverse the disease process and

How to cite this article: Sandeep Nandamuri, Y S Arun Kumar Reddy. Evaluation of cerebral venous sinus thrombosis as a prognostic profile with MR imaging. *MedPulse International Journal of Radiology*. August 2020; 15(2): 31-34.
http://www.medpulse.in/Radio%20Diagnosis/

remarkably decrease the risk of acute complications and long-term sequel [3]. A high reading index of suspicion for CVT and imaging of specific venous are required to make a diagnosis. This is especially true in the case of neonates, who have nonspecific presentations of signs and symptoms that consist solely of seizures in the majority[4-6]. Without CT or MRI interventions, many cases would be missed since the clinician is not sure and unsuspected of this disease. With the universal availability of CT and MRI and the awareness of pathology among general physicians and obstetricians about such symptoms, the rate of diagnosis of this disease has increased manifold during the last two decades. Many a time cerebral venous thrombosis is unsuspected by the treating clinician that the disease is first diagnosed by the radiologists[6]. Radiologist role is much more critical such as the radiologist has to diagnose cerebral venous thrombosis swiftly. Since with primary treatment, the pathology is almost entirely reversible and so has an excellent chance of prognosis. Mainly, Catheter angiography is the gold standard procedure for early detection and diagnosing venous thrombosis. Nevertheless, in recent times, the preferred modalities are CT and MRI since they are non-invasive, cheap and with little risk to the patient[7]. Traditional CT, is one of the best modality for diagnosis of patients with any CNS signs and symptoms. Moreover, more than 80% of cerebral venous thrombosis can be diagnosed with this. This modality is also useful in ruling out intracranial tumours and infections[8]. The MRI and MRV are one of the more sensitive procedures than CT in diagnosing cerebral venous thrombosis in patients. It can also help in the mapping of the extent of parenchymal lesions and thrombosis. Within specific criteria, MRI can also give a prognostic valuation of the disease[8-10]. In our study we have evaluated the diagnosis of CVT on plain head CT scan, conventional MRI sequences and MRV to arrive at the diagnosis of cerebral venous thrombosis and to study the brain parenchymal changes associated with it.

MATERIALS AND METHODS

Our study is a prospective cohort study of 55 patients carried out at Department of Radiodiagnosis, Mamata Academy of Medical Sciences, Bachupally, from January 2019 to November 2019 and includes fifty-five patients of all age groups. All the 48 patients were subjected to MRI and MRV. MRI was performed using 1.5 Tesla using a head coil.

Patient examinations: The patient was placed in the supine position in the MR gantry with the head coil positioned.

MR Techniques: Multiplanar scout sections obtained for planning the sequences. Whole-brain MR from vertex to the foramen magnum including the base of the skull is taken using axial coronal and sagittal sections. Many of the patients presented with CNS signs and symptoms, and some were suspicious of CVT and others with vague features.

Patient recruitment: All the patients were selected based on findings by MRI and MRV as cerebral venous sinus thrombosis. Patients with MR incompatible devices or implants, patients on life support systems, claustrophobia were not considered for this study.

MRI Findings: Haemorrhage, thrombosis within sinuses, T2 hyper intense lesion in superficial and deep cerebral regions, Diffusion Restriction, Diffusion-weighted images were recorded. CT, both NECT and CECT were taken using 5 mm posterior fossa sections and 10mm supra-tentorial sections.

Follow up: Follow-up of all patients at eight weeks was done. The observations were classified as a poor outcome, which was pre-defined as either death or focal neurological deficit at the end of eight weeks. In our study, at the end of 8 weeks, three patients were dead; all died in the acute phase of the disease. Three patients had hemiparesis, one had paresis of the right upper limb, and two had hemiparesis with dysphasia.

Statistical analysis: The statistical analysis of research data was carried out with SPSS software.

Ethical Committee approval was taken for study from Institute.

RESULT

Table 1: The tabular representations of age distribution and its relation with various parameters

Parameter	Age distribution								Total	
	< 20		20 - 30		30 - 40		> 40			
	Count	%	Count	%	Count	%	Count	%	Count	%
Normal	08	66.67	11	78.57	14	70	07	77.77	40	72.73
Deficit	04	33.33	02	14.28	04	20	01	11.11	11	20
Death			01	7.14	02	10	01	11.11	04	7.27
Total	**12**	**100**	**14**	**100**	**20**	**100**	**09**	**100**	**55**	**100**

In our study, 55 patients were included, and all these patients were selected with MR evidence of cerebral venous sinus thrombosis. The age range of the affected patients is 18 to 66, with a mean age of 33.

Table 2: The tabular representations of gender wise association with various parameters

Gender	Follow-up						Total	
	Normal		Deficit		Death			
	Count	%	Count	%	Count	%	Count	%
Male	13	32.5	4	36.36	1	25	18	32.73
Female	27	67.5	7	63.64	3	75	37	67.27
Total	**40**	**100**	**11**	**100**	**04**	**100**	**55**	**100**

The Male: Female sex ratio in our study is 1:2.7; that is, males, form 27% of the patients. This highlights that CVT is not rare among males and should be a differential diagnosed in any patient with the suspicious CNS signs and symptoms. Gender does not play a significant role in the outcome of CVT in our study.

Table 3: The tabular representations of puerperium and its relation with various parameters

Parameter	Puerperium				Total	
	Positive		Negative			
	Count	%	Count	%	Count	%
Normal	23	79.31	7	87.5	30	81.09
Deficit	4	13.79			4	10.81
Death	2	6.90	1	12.5	3	8.10
Total	**29**	**100**	**8**	**100**	**37**	**100**

Out of 37 female patients, 29 were puerperal patients. There is no significant association with prognosis of CVT. Among all the patients, the female patients were in the puerperal period, i.e. 67%. This proves that puerperium is a high risk of CVT. The outcome among puerperal females does not show any significant difference from the non-pregnant female.

Table 4: The tabular representations of headache and its relation with various parameters

Parameter	Headache				Total	
	Positive		Negative			
	Count	%	Count	%	Count	%
Normal	38	79.17	7	100	45	81.82
Deficit	7	14.53			7	12.73
Death	3	6.25			3	5.45
Total	**48**	**100**	**7**	**100**	**55**	**100**

48 (87.27%) patients out of 55 presented with complaints of headache.

Table 5: The tabular representations of CT-Parenchymal haemorrhage and its relation with various parameters

Parameter	CT-Parenchymal haemorrhage				Total	
	Positive		Negative			
	Count	%	Count	%	Count	%
Normal	9	60	37	92.5	46	83.64
Deficit	4	26.67	2	5	6	10.91
Death	2	13.33	1	2.5	3	5.45
Total	**15**	**100**	**40**	**100**	**55**	**100**

This association is highly significant ($p < 0.001$).

Table 6: The tabular representations of CT-SSS thrombosis association with various parameters

Parameter	CT-SSS thrombosis				Total	
	Positive		Negative			
	Count	%	Count	%	Count	%
Normal	34	75.56	10	100	44	80
Deficit	8	17.78			8	14.55
Death	3	6.66			3	5.45
Total	**45**	**100**	**10**	**100**	**55**	**100**

The presence of parenchymal hypodensity in patients which can be either simple vasogenic oedema or a venous infarct was found in patients. This has a highly significant association with poor outcome with $P < 0.001$.

Table 7: The tabular representations of CT-Hypodensity association with various parameters

Parameter	CT-Hypodensity				Total	
	Positive		Negative			
	Count	%	Count	%	Count	%
Normal	6	50	40	93.03	46	83.64
Deficit	3	25	3	6.97	6	10.91
Death	3	25			3	5.45
Total	12	100	43	100	55	100

Table 8: The tabular representations of MRI-Haemorrhage and its relation with various parameters

Parameter	MRI-Haemorrhage				Total	
	Positive		Negative			
	Count	%	Count	%	Count	%
Normal	22	70.97	19	79.17	41	74.55
Deficit	6	19.35	5	20.83	11	20
Death	3	9.68			3	5.45
Total	31	100	24	100	55	100

This association is highly significant ($p < 0.05$).

Table 9: The tabular representations of MRI-SSS thrombosis association with various parameters

Parameter	MRI-SSS thrombosis				Total	
	Positive		Negative			
	Count	%	Count	%	Count	%
Normal	33	76.74	12	100	45	81.81
Deficit	7	16.27			7	12.73
Death	3	6.97			3	5.45
Total	43	100	12	100	55	100

The presence of parenchymal hypodensity in patients which can be either simple vasogenic oedema or a venous infarct was found in patients. This has a highly significant association with poor outcome with $P < 0.001$.

Table 10: The tabular representations of MRI-T2 Hyperintensity association with various parameters

Parameter	MRI-T2 Hyperintensity				Total	
	Positive		Negative			
	Count	%	Count	%	Count	%
Normal	36	85.72	10	76.92	46	83.64
Deficit	3	7.14	3	23.08	6	10.91
Death	3	7.14			3	5.45
Total	42	100	13	100	55	100

Table 10: The tabular representations of MRI-Diffusion restriction association with various parameters

Parameter	MRI-Diffusion restriction				Total	
	Positive		Negative			
	Count	%	Count	%	Count	%
Normal	16	76.19	34	100	50	90.91
Deficit	3	14.29			3	5.45
Death	2	9.54			2	3.64
Total	21	100	34	100	55	100

DISCUSSION

Cerebral venous sinus thrombosis is a frequently misdiagnosed condition because of its variability of clinical symptoms and signs. It is very often missed on initial imaging. All age groups can be affected. The prognosis of cerebral venous sinus thrombosis depends on an early and accurate diagnosis of CVT. Our study shows the importance of the role of MRI with MRV, DWI with ADC mapping, and gradient-recalled echo in the early and precise diagnosis of CVT[11]. Regarding brain parenchymal abnormality, CT could detect oedema in 15 (30%) of cases and MRI in 26 (52%) of cases. Haemorrhagic infarct was seen in 26% of patients on MRI as compared to 22% on CT. It was reported that focal brain parenchymal abnormalities are visualised in 57% of cases. Oedema without haemorrhage was reported in 8% cases on CT scan and 25% cases on MRI[12]. In the earlier published study reported that in the acute stage, the thrombus is usually isointense on T1WI and hypointense on T2WI. In the late subacute stage, the thrombus is usually hyperintense on both T1 and T2. In the chronic stage, it is hyperintense on

T2 and isointense on T1.[13-15] Diffusion-weighted imaging (DWI) can detect changes in water diffusion associated with cellular dysfunction and can be used to diagnose the ischemic lesions of the brain within the first few hours of stroke onset. The application of DWI in diagnosing acute arterial stroke is well established. It shows a first decrease and late increase or normalisation, of the apparent diffusion coefficient (ADC)[15,16]. Although both vasogenic and cytotoxic oedema are identified in the early phase of CVT, vasogenic oedema develops more frequently. Our study showed coexistence of increased and decreased ADCs in haemorrhagic infarcts. Increase in ADC suggests the predominance of vasogenic oedema and a decrease in ADC suggests cytotoxic oedema[17]. Gradient-recalled echo is a critical technique that detects early haemorrhagic transformations within acute infarctions accurately. It also detects chronic microbleeds and intracerebral hematomas, thus warning the treating physician about the devastating complication of anticoagulant and revascularisation therapies[18]. CVT presents with variable clinical presentation in all the age groups and both sexes, though more common in young female patients. In the emergency setting, CT scan plays a vital role in evaluating patients clinically suspected CVT, and all the patients who showed a hyperdense sign on plain head CT scan were found to have CVT on MRI and MRV [19]. For patients with equivocal findings on CT scan, MRI combined with MR Venography is the best imaging technique for the diagnosis of cerebral venous thrombosis.

CONCLUSION

In our study of cerebral venous thrombosis, it can be concluded that MRI is useful in prognostic evaluation. Diffusion-weighted images are proper prognostic tools. Restriction of diffusion is a poor prognostic indicator. MRI features of deep T2 hyperintense lesions, intraparenchymal haemorrhage and straight sinus thrombosis, are poor prognostic factors.

REFERENCES

1. Ahmed N, Kumar AP, Chouhan S, Ismail S, Afreen U. Role of Magnetic Resonance Venography, Diffusion Weighted Imaging, and Gradient-Recalled Echo in Cerebral Sino venous Thrombosis. Int J Sci Stud 2018;6(5):1-5.
2. Benamer HT, Bone I. Cerebral venous thrombosis: Anticoagulants or thrombolytic therapy. J NeurolNeurosurg Psychiatry 2000; 69:427-30.
3. Rother J, Waggie K, Van Bruggen N, De crispigny AJ, Moseley ME. Experimental cerebral venous thrombosis: Evaluation using magnetic resonance imaging. J Cereb Blood Flow Metab1996; 16:1353-61.
4. Wagner E, Traystman R. Effects of cerebral venous and cerebrospinal fluid pressure on cerebral flow. In: Auer L, Low F, editors. The Cerebral Veins. New York: Springer; 1983. p. 223-30.
5. Gotoh M, Ohmoto T, Kuyama H. Experimental study of venous circulatory disturbance by dural sinus occlusion. Acta Neurochir1993; 124:120-6.
6. Kurokawa Y, Hashi K, Okuyama T, Uede T. Regional venous ischemia in cerebral venous hypertension due to embolic occlusion of superior sagittal sinus in the rat. SurgNeurol1990; 34:390-5.
7. Garcia J. Thrombosis of cerebral veins and sinuses: Brain parenchymal effects. In: Einhaupl K, Kempski O, Baethmann A, editors. Cerebral Sinus Thrombosis. New York: Plenum Press; 1990. p. 27-37.
8. Corvol JC, Oppenheim C, Manaï R, Logak M, Dormont D, Samson Y, *et al.*. Diffusion-weighted magnetic resonance imaging in a case of cerebral venous thrombosis. Stroke 1998; 29:2649-52.
9. Manzione J, Newman GC, Shapiro A, Santo-Ocampo R. Diffusion-and perfusion-weighted MR imagings of dural sinus thrombosis. AJNR Am J Neuroradiol2000; 21:68-73.
10. Keller E, Flacke S, Urbach H, Schild HH. Diffusion-and perfusionweighted magnetic resonance imaging in deep cerebral venous thrombosis. Stroke 1999; 30:1144-6.
11. Ducreux D, Oppenheim C, Vandamme X, Dormont D, Samson Y, Rancurel G, *et al.*. Diffusion-weighted imaging patterns of brain damage associated with cerebral venous thrombosis. AJNR Am J Neuroradiol2001; 22:261-8.
12. Mohapatra S, Manjari B, Jayashree M. Prognostic evaluation of cerebral venous sinus thrombosis using clinical and MR sequences. J Neurol Neurophysiol 2004; 5:4.
13. Atlas SW, Dubois P, Singer MB, Lu D. Diffusion measurements in intracranial hematomas: implications for MR imaging of acute stroke. AJNR Am J Neuroradiol 2000; 21:1190-1194.
14. Favrole P, Guichard J, Crassard I, Bousser MG, Chabriat H. Diffusion weighted imaging of intravascular clots in cerebral venous thrombosis. Stroke 2004; 35:99-103.
15. Mittal S, Wu Z, Neelavalli J, Haacke EM. Susceptibility-Weighted Imaging: Technical Aspects and Clinical Applications, Part 2. AJNR 2009; 30:232-252.
16. Tang M, Chen T, Zhang X, Huang X. GRE T2 -Weighted MRI: Principles and Clinical Applications. BioMed Research International 2014, Article ID 312142, 12 pages, 2014.
17. Linna J, Pfefferkornb T, Ivanicovaa K, Müller-Schunka S, Hartza S, Wiesmanna M *et al.*. Noncontrast CT in Deep Cerebral Venous Thrombosis and Sinus Thrombosis: Comparison of its Diagnostic Value for Both Entities. AJNR 2009; 30:728-735.
18. Colin S, Ja-Kwei C, Amar S, Michael H, John W. Radiologic diagnosis of cerebral venous thrombosis: Pictorial review. AJR 2007; 189: S64-75.
19. Connor SEJ, Jarosz JM. Magnetic resonance imaging of cerebral venous sinus thrombosis. Clin Radiol 2002; 57:449–461.

Source of Support: None Declared
Conflict of Interest: None Declared