Original Article

Role of Neuroimaging in Diagnosis of Cerebral Venous Thrombosis

Fatima Imran[1], Nayab Alia[2], Zonia Zaman[3]

[1]Assistant Professor, Department of Radiology, Aziz Fatimah Hospital, Faisalabad, [2]Associate Professor, Department of Radiology, University Medical and Dental College, Faisalabad, [3]Associate Professor, Department of Obstetrics and Gynaecology, Aziz Fatimah Hospital, Faisalabad

***Address of Correspondence**: Dr. Fatima Imran, Assistant Professor, Department of Radiology, Aziz Fatimah Hospital, Faisalabad*
dr.fatimaimran@gmail.com

Abstract

Objective: To evaluate the role of neuroimaging in the diagnosis of cerebral venous thrombosis.
Study Design: Cross-sectional study
Duration of Study: The study was conducted in Department of Radiology, Aziz Fatimah Trust Hospital and Medical and Dental College Faisalabad, from February 2015 to July 2016 in a period of one and half year.
Methodology: Patients of both genders and belonging to any age group were included in the study. Written informed consent was taken from all participants, before enrolling for the study. The patients who had financial constraint or medical incompatibility for neuroimaging due to technical or medical reasons like metallic implants or claustrophobia were excluded from the study. All the patients underwent through neuroimaging techniques that is CT venography, MRI and MRV and special focus was on location and extent of thrombotic changes, hemorrhagic foci, the presence of ischemia etc. during the study of images by any technique.
Results: A total of 83 suspected patients of cerebral venous thrombosis were included. The mean age of the patients was 38.42±4.48 with the main bulk of the patients (71%) having age between interval of 24-37 years. There were 55 (66.26%) females and 28 (33.73%) male patients in the study sample. On the basis of different imaging techniques and clinical findings, 63 patients were confirmed to have cerebral venous thrombosis and 20 suspected patients were found CVT negative. The most common risk factor in confirmed cases of CVT was puerperium and use of oral contraceptives in 28 (44%) patients followed by Central Nervous System (CNS) infection in 8 (13%) patients. Maximum patients presented with a headache 52 (82.54%) and neurological deficits in 46 (73%) along with altered mental status seen in 35 (55.55%) patients. The best method of diagnosis of CVT are CT venography and combination of MRI and MRV with the highest sensitivity of 92.06% and 88.89% for diagnosis of CVT.CTV had the highest accuracy in detection of cerebral venous thrombosis with an overall accuracy of 90.36% followed by a combination of MRI and MRV with an overall accuracy of 89.15%.
Conclusions: The diagnosis of cerebral venous thrombosis is not possible without neuroimaging because there is huge variation in the clinical picture of CVT. The best method of diagnosis of CVT are CT venography and combination of MRI and MRV with the highest sensitivity of 92.06% and 88.89% for the diagnosis of CVT.

Key words: Cerebral venous Thrombosis, CT venography, MRI & MRV,

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Introduction

Cerebral venous thrombosis (CVT) is a disease which can occur in all age groups but its diagnosis is quite problematic due to which its treatment become challenging. Its diagnosis is hard because its symptoms

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are usually nonspecific and vary from patient to patient. The patients customarily present with isolated headache, problems with auditory or visual senses to very severe problems like hemiparesis and coma. [1]

Venous thromboembolism have multiple types including cerebral venous thrombosis, which is an uncommon form of this disease. CVT is not so common it contributes almost 0.5% to 3% in all types of stroke, most of the time it occurs in younger people. In a study conducted in Karachi and Dubai, it was noted that mean age of the patients of CVT was 35.8 years showing the further difference in mean age of females and males with mean age of 33.2 years for females and 38.7 years for males. CVT is thought to be more common in females having a rate of up to 75% to be females in all adult patients presenting with CVT. [2,3]

Cerebral venous thrombosis is a condition which is resultant of the thrombosis development inside the cerebral venous sinuses. This is a rare condition but has a great importance clinically because delay in its diagnosis may result in serious morbidity and mortality.[4]

Cerebral venous sinus thrombosis is more common in the Asian region as compared to other world. A study conducted in India showed that about half of the young patients presenting with stroke had CVT and similarly 40% women had CVT among the women who presented with stroke. So CVT has greater importance and should be considered with a high index of suspicion. CVT has very good prognosis nowadays if it is diagnosed early and treated with care. [5]

There is immense variation in clinical and radiographic findings of different patients of CVT, which makes the diagnosis difficult. The main diagnosis of CVT is based upon neuroimaging from which magnetic resonance imaging has a key role for diagnosis as well as follow-up of these patients. [6]

The diagnosis of CVT has been a challenge for radiologists and physicians but the improvement in magnetic resonance imaging has increased our ability to diagnose CVT. The main hurdle which makes the diagnosis difficult is variation in radiological and clinical presentations of CVT. The findings of combination of MRI with MRV have shown high sensitivity in diagnosis of CVT. [7, 8]

CT venography is another imaging technique used to detect CVT which is a cheaper and quicker test as compared with magnetic resonance venography (MRV), considered as a gold standard technique to diagnose CVT. But some studies have shown that CT venography give better results to identify the cerebral veins and dural sinuses. Its results are about comparable for diagnosis of CVT to other gold standard techniques along with other advantages.[9] Other advantages of CTV are a reduction in motion related artifacts, fewer equivocal imaging findings with increased imaging resolution, and it has no contraindication to a pacemaker and ferromagnetic devices. [10]

CT venography has quite high sensitivity approximately 95% which is somewhat better than other imaging techniques like DSA and MRI for study of images of the cavernous sinus, inferior sagittal sinus" With the advancement of technologies CT venography is also improved in all aspect like shortening of time for diagnosis which helps in execution of appropriate treatment strategy. So this study was planned to investigate the role of neuroimaging techniques like MRI, MRV and CTV for the diagnosis of CVT in our study population.

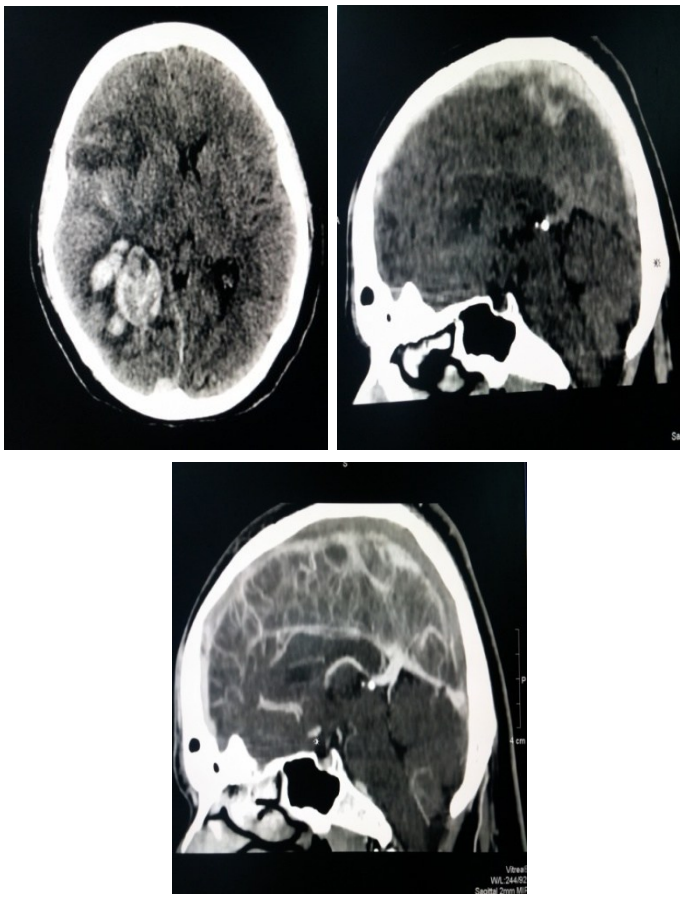

Figure 1: Unenhanced CT Axial and Sagittal images shows abnormal hyperattenuation in the superior sagittal sinus with venous hemorrhagic infarct in right parieto-occipital region. CTV of same patient confirms the presence of thrombus in superior sagittal sinus.

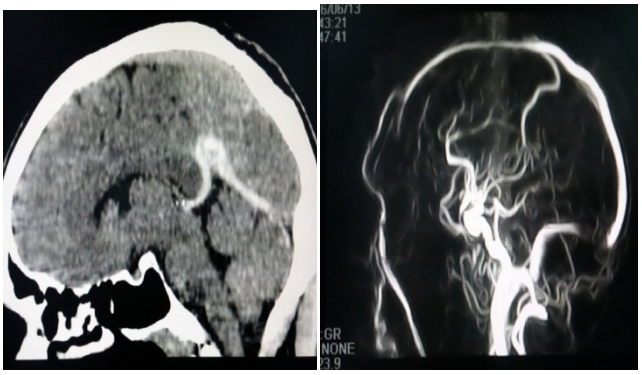

Figure 2: unenhanced CT Sagittal image shows high attenuation areas in great cerebral vein and straight sinus. MRV of same patient confirms the presence of thrombus.

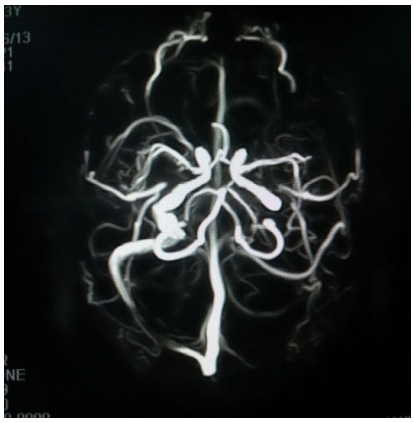

Figure 3: MRV Shows thrombus in left transverse and sigmoid sinuses and partial thrombus in right transverse sinus

Methodology

This descriptive study was started after taking approval from hospital ethical committee. A total of 83 suspected patients of cerebral venous thrombosis, visiting the radiology and neurology department, Aziz Fatimah Trust Hospital and Medical and Dental College Faisalabad were included. This study consisted of a period of one and a half year from February 2015 to July 2016.

Patients of both genders and belonging to any age group were included in the study. All the patients were briefly described the study and written informed consent was taken from all participants, before enrolling for the study. The patients who had a financial constraint for neuroimaging like MRI, MRV or CTV tests and the patients who had medical incompatibility for these tests due to technical or medical reasons like metallic implants or claustrophobia were excluded from the study. All the patients underwent neuroimaging techniques that is CT venography, MRI and MRV and special focus was on location and extent of thrombotic changes, hemorrhagic foci, presence of ischemia etc during study of images by any technique.

Other demographic characteristics including age, gender, risk factors and presenting complaints as well as comorbidities were also investigated and recorded on a predesigned Performa. Detailed clinical assessment of the patients were made along with radiological assessments. The patient was considered as suspected for CVT if he presented with headache, signs of raised intra-cranial pressure and focal neurological abnormalities, (e.g., abnormal vision, stroke-like symptoms such as weakness of the face and limbs on one side of the body and seizures).

For imaging purposes a multiplanar/mult isequential, Tesla 1.5 MRI/MRV time of flight images were done in all suspected cases of cerebral venous thrombosis. Computed Tomography (CT), magnetic resonance imaging (MRI), or Magnetic Resonance Venography(MRV) of brain were done to demonstrate obstruction of the venous sinuses by thrombus.

All the collected data was entered and analyzed through SPSS v. 20. Quantitative data was presented in the form of mean and standard deviation and qualitative data was presented with the help of frequency and percentages.

Results

In this cross-sectional study, a total of 83 suspected patients of cerebral venous thrombosis were included. The mean age of the patients was 38.42±4.48 with a range of 21 to 56 years. The main bulk of the patients (71%) had aged in the interval of 24-37 years. There were 55 (66.26%) females and 28 (33.73%) male patients in the study sample. On the basis of different imaging techniques and clinical findings, 63 patients were confirmed to have cerebral venous thrombosis and 20 suspected patients were found CVT negative. The patients who were confirmed with CVT were further analyzed.

The distribution of risk factors for CVT in confirmed patients showed that the most common risk factor found was puerperium and use of oral contraceptives in 28 (44%) patients followed by Central Nervous System (CNS) infection which was noted in 8(13%) patients and Para-Nasal Sinuses/Mastoid infections found in 6 (10%) of the patients. Hypercoagulable states was also a major contributor for CVT and in this study 4 (6%) patients presented with this condition. Systemic Lupus Erythematosis was observed in 1 (2%) patients. In

others 16(25%) no definite risk factor was found. (Table I)

Table I: Sensitivity and specificity of different imaging techniques

Risk factors	No. of Patients	Percentage
Puerperium/OCP use	28	44%
Central Nervous System (CNS) infection	8	13%
Para-Nasal Sinuses (PNS)/ Mastoid infections	6	10%
Hyper-coagulable states	4	6%
Systemic Lupus Erythematosis	1	2%
Unknown Cause	16	25%
Total	63	100%

According to the results of presenting complaints in confirmed patients the most common complaint was headache which was seen in 52 (82.54%) patients and neurological deficits which were observed in 46 (73%) patients along with altered mental status seen in 35 (55.55%) patients. Similarly, 19 (30.16%) patients had papilledema and 11 (17.46%) patients presented with seizures.

The distribution of location of cerebral thrombosis showed that superior sagittal sinus was the most common location where the thrombosis was found in 21 (33%) patients followed by sigmoid sinus where thrombosis was found in 15 (24%) patients and in 12(19%) of the patients, thrombosis was observed in transverse sinus. Similarly, thrombosis was also found in internal jugular bulb among 8 (13%) patients and sinus rectus in 3 (5%) patients of cerebral venous thrombosis as elaborated in (Table II).

Table II: Distribution of Risk Factors found in patients of CVT

Localization of Cerebral Thrombosis	No. of Patients	Percentage
Superior sagittal sinus	21	33%
Sigmoid sinus	15	24%
Transverse sinus	12	19%
Internal jugular bulb	8	13%
Sinus rectus	3	5%
Deep cerebral veins	2	3%
Inferior sagittal sinus	1	2%
Cortical veins	1	2%
Total	63	100%

The results of the analysis showed that CTV had highest accuracy in detection of cerebral venous thrombosis with an overall accuracy of 90.36% followed by combination of MRI and MRV with overall accuracy of 89.15%. The sensitivity, specificity, positive predictive value (PPV) and negative predictive values (NPV) were 92.06% & 88.89%, 85.0% & 90.0%, 95.08% & 96.55% and 22.72% & 28.0% respectively for CTV and combination of MRI and MRV. But the diagnostic values for MRI and MRV were not so good when their results were analyzed individually. The overall accuracy values were 86.75% and 79.52% for MRV and MRI. The sensitivity and specificity values were 88.89% & 76.19% and 80.0% & 90.0% for MRV and MRI respectively. (Table III)

Table III: Distribution of Location of Cerebral Thrombosis

Imaging Technique	Sensitivity	Specificity	PPV	NPV	Accuracy
CTV	92.06%	85.0%	95.08%	22.72%	90.36%
MRV	88.89%	80.0%	93.33%	30.34%	86.75%
MRI	76.19%	90.0%	96.0%	45.45%	79.52%
MRI+MRV	88.89%	90.0%	96.55%	28.0%	89.15%

Discussion

The timely diagnosis of cerebral venous thrombosis has been a great challenge for neurologists due to its diverse presentation. With the passage of time the technology in every field is improving. The knowledge and expertise for the diagnosis and treatment of stroke has improved extensively. This is very helpful for the understanding of the pathophysiology of cerebral venous thrombosis. However, the optimum technique for diagnosis of CVT is debatable and requires rigorous evaluation for its authenticity and feasibility before its extensive use.[12]

The knowledge of pathophysiology of cerebral venous thrombosis guides us to understand the imaging indicators and natural evolution of venous infarcts. There are several reasons of CVT and it can appear unexpectedly or in a result of any infection, trauma, or as a complication of surgery.

Other risk factors which contribute towards development of CVT are hypercoagulability due to dehydration, use of oral contraceptives, pregnancy, puerperium, genetic causes and chronic physiologic states like malignancy. [13]

Cerebral venous thrombosis is not a common neurological condition but it has very severe outcomes. It usually occurs in younger adults and is frequently observed in females during childbearing age. Though this condition can also affect individuals from all age groups. In this present study, the mean age of the patients was 38.42±4.48 with a range of 21 to 56 years.

The main bulk of the patients (71%) had aged in the interval of 24-37 years. Other studies have shown results in an agreement to this study like in a multinational and multicenter study by Ferro JM et al, the mean age was found 37 years among patient of CVT same like the study of de Bruijn SF who also found the mean age of 37 years.[14, 15] Another study by Karadas S showed less mean age of 32 years. [16]

The literature shows that cerebral venous thrombosis is dominant among female population like in study conducted in Isfahan, it was observed that there 78.7% female and only 21.3% males in a study sample of a patient having CVT.[17] In this present study, it was observed that there were 66.26% females and 33.73% male patients in the study sample. These results are very close to the results of the study conducted by Misra et al in which he found 62.1% female patients and 37.9% male patients, showing a female predominance towards this condition. [18]But some studies have shown different results like in a study by Narayan D conducted in India, females were 46.3% and male patients were 53.7%. [19]

In our study it was observed that the most common complaint was a headache in 78.84% patients, followed by focal neurological deficits in 71.15% patients, and altered mental status 69.23% patients. These results are in very much agreement with other studies like the study by Ferro JM et al, de Bruijn SF et al who found the most common presenting complaint in patients of CVT was a headache in both studies having a frequency of 88.8% and 95%. [14, 15]

Different imaging techniques have shown different efficacies with different aspects. The pathophysiological development process of cerebral venous thrombosis can be predicted more precisely on the basis of MRI findings. MRV has very good results in reflecting blood flow condition through the venous sinus without influenced by thrombus signal time change. Likewise, it has the ability to more visibly disclose the signs of local edema or hemorrhage of the brain parenchyma. So the combination of MRI and MRV can be considered a better strategy to diagnose the CVT. [20, 21]

The results of present study revealed that for diagnosis of CVT the findings of MRI alone were very sensitive but its specificity was very low and the specificity of MRV alone was very high along with low sensitivity. On the basis of results, CT Venography had highest accuracy in detection of cerebral venous thrombosis with an overall accuracy of 90.36% followed by a combination of MRI and MRV with overall accuracy of 89.15%. The sensitivity for detecting the CVT was 92.06% from the finding of CT Venography and 88.89% from the combination of MRI and MRV. The results are in agreement with other studies as observed by Sajjad Z, who noticed the diagnostic sensitivity of combination of MRI and MRV as 90% or more.[22] Even better results in terms of sensitivity were found by Qu H et al, who found the sensitivity of MRI and MRV combination to 96.43%, revealing that the combination of MRI and MRV can be considered one of the best diagnostic tool for CVT where this facility is available. [23]

CT venography has many advantages over MRI and MRV. CTV is a test which can be performed quickly and comparatively it is quite cheap in contrast to MRI and MRV. CT venography is considered better for differentiating cerebral veins and dural sinuses as well. It has also better results in terms of sensitivity as supported by our study. [24, 9]

Cerebral venous thrombosis is not a common disease and it can be well treated if promptly diagnosed and properly treated with care. The pathogenesis of CVT is multifactorial and this disease can occur in any age group. CVT has no specific symptoms and presentation, so it is hard to diagnose it. Its diagnosis mostly depends on upon the neuroimaging techniques and radiologists have a key role in diagnosis and providing better care through an appropriate explanation of imaging studies. Severe complications like hemorrhagic stroke or death can occur if the CVT is not diagnosed and treated in time.

Conclusion

The diagnosis of cerebral venous thrombosis is not possible without neuroimaging because there is a huge variation in the clinical picture of CVT. The most common risk factor was puerperium and use of oral contraceptives in (44%) patients and the most common complaint was a headache in (78.84%) patients, followed by focal neurological deficits in (71.15%) patients, and altered mental status (69.23%) patients. The best method of diagnosis of CVT are CT venography and combination of MRI and MRV with the highest sensitivity of 92.06% and 88.89% for the diagnosis of CVT.

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