ORIGINAL RESEARCH PAPER

Radiology

CEREBRAL MAGNETIC RESONANCE VENOGRAPHY IN PEDIATRIC POPULATION – NORMAL ANATOMIC VARIANTS, ARTIFACTS AND PITFALL IN DIAGNOSING CEREBRAL VENOUS THROMBOSIS

KEY WORDS:

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ABSTRACT

Aim: In pediatric population many number of cases are admitted for Cerebral venous thrombosis where MR venogram place a pivotal role[5]. The prevalence of normal anatomic variant in the venous system becomes a pitfall[9] in the diagnosis of dural sinus thrombosis[4]. The purpose of this study is to evaluate the normal intra cranial venous anatomy and its variants to avoid potential pitfalls in the misdiagnosing dural sinus thrombosis. **Methods:** This is a retrospective observational study conducted in department of radiodiagnosis, Institute of child health & hospital for children, Madras Medical college, Chennai, from January 2018 to June 2018. The normal MR venography reported in 146 children were analyzed for the prevalence of anatomic variants and they are categorized on the basis of the variants such as hypoplasia of transverse, sigmoid sinus, presence of absence of occipital sinus etc. **Results:**On analyzing the MR venography of n-146 children, 56.8% (n-83) were male children & 43.2% (n-63) were female children. Normal MR venography was seen in 64.4% (n-94) & anatomic variant was seen 35.6% (n-52). In this anatomic variant MR venography, most common variant was hypoplasia left transverse sinus (48%), then followed by right transverse and sigmoid sinus (21%). Hypoplasia involving multiple sinuses was seen in 11.5% (n-6). In this multiple domain, hypoplasia were seen in right transverse, right sigmoid, right IJV and left transverse sinus in toto. In subgroup analysis of our data into infant and children less than 12years, there is no significant difference in the pattern of hypoplasia of the dural venous sinus except hypoplasia of multiple sinuses was predominantly seen in infant arm. **Conclusion:** This study clearly explains the prevalence of anatomic variant of intracranial venous system in pediatric population. By analyzing this study, it clearly explicit that the reporting radiologist should be aware of the normal anatomy and its variants before coming to final conclusion thereby avoiding pitfalls[9] in the diagnosis of dural venous sinus thrombosis.

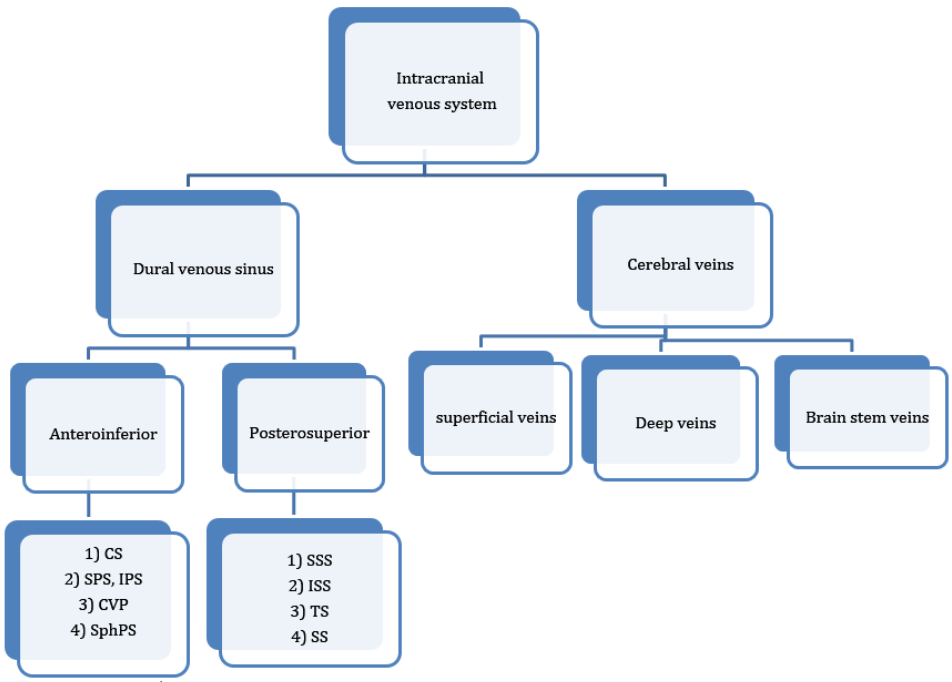
INTRODUCTION

Cerebral venous thrombosis is reversible medical emergency where prompt diagnosis and treatment is life saving especially in pediatric population. Children are more prone for this illness as dehydration, infection, trauma, blood coagulation disorders are very common in this population. Dural venous sinuses occlusion producing cerebro vascular accidents are often missed due to difficulty in diagnosis both clinically and radiologically.. On flip side of this, few cases are misinterpreted as cerebral venous thrombosis due to lack of knowledge of anatomic variants, which is very common in cerebral venous drainage. MR venography is preferred diagnostic tool as it is non invasive, non radiation, non contrast enhanced modality. It also helps to identify the complications and to differentiate other disease in addition.

Normal anatomy

The anatomy of cerebral venous drainage system is different from other systemic venous drainage. Cerebral venous sinuses lack valves facilitating bi-directional blood flow[1]. The venous system doesn't accompany the arteries; hence their occlusion doesn't resemble the arterial distribution[1].

The intracranial venous system is composed of superficial dural venous sinuses and deep cerebral venous system. The dural cerebral venous system is divided into anteroinferior and posterosuperior group.



Anteroinferior group consists of the following

1) Cavernous sinus (CS)
2) Superior petrosal sinus (SPS), Inferior petrosal sinus (IPS)
3) Clival venous plexus (CVP)
4) Sphenoparietal sinus(SphPS)

Posterosuperior group consists of the following

1) Superior sagittal sinus
2) Inferior sagittal sinus
3) Transverse sinus
4) Straight sinus

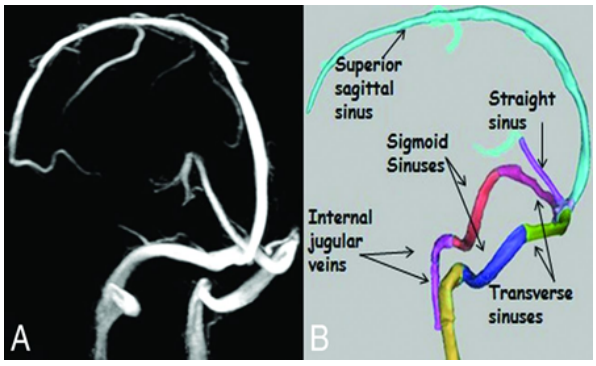


Figure 1. Normal sagittal MRV anatomy

MATERIALS AND METHOD OF THE STUDY

This is a retrospective observational study conducted in the department of radiodiagnosis, Institute of child health and hospital for children, Madras Medical College, Chennai. MR venography was done with Philips Achieva 1.5 Tesla MRI system. Phase contrast MRV method was employed in our imaging. The recorded MR venography images of patients from January 2018 till June 2018 were taken for the study. Clinical histories of patients were taken along with MR venography images. The patients having full blown picture of cerebral venous thrombosis, cerebrovascular accident in arterial distribution, hypoxic ischemic encephalopathy, inherited & metabolic disorders were excluded. After applying exclusion criteria, 146 patients MR venography images were taken for the analysis.

MR venography images were analysed in the pattern of hypoplasia of dural sinuses in solo and in combination. Demographic distribution in terms of age and sex of the study population was done. The entire study population was sub analyzed into infant and children arm.

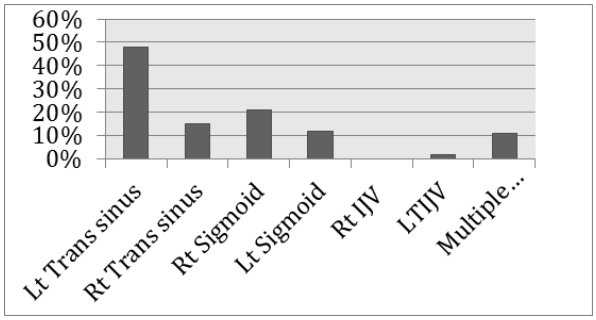
RESULTS

On analyzing the MR venography of n-146 children, 56.8% (n-83) were male children & 43.2% (n-63) were female children. MR venography was reported as normal when the following patterns were seen. Superior sagittal sinus is seen as sickle shaped structure abutting inner table of the skull[1]. The straight sinus is formed by junction of inferior sagittal sinus and vein of Galen. It terminates by joining the superior sagittal sinus and transverse sinus to form venous sinus confluence[1]. Transverse sinus curves laterally from torcular to posterior petrous temporal bone where it turns inferiorly and form sigmoid sinus which descends behind the petrous temporal bone and terminates as internal jugular vein[1]. In our study this normal pattern of MR venography was seen 64.4% (n-94).

The anatomic variant of MR venography not consistent with normal MR venography pattern was seen 35.6% (n-52). In this anatomic variant MR venography, most common variant was hypoplasia left transverse sinus [6,7](48%), followed by right transverse and sigmoid sinus (21%). Hypoplasia involving multiple sinuses was seen in 11.5% (n-6). This reflects that right transverse sinus was dominant in children and co dominance of both transverse sinus was seen in normal population. Right occipital sinus was seen 19% (n-10), which reflects the alternate pathway of venous drainage whenever there is hypoplasia of ipsilateral transverse sinus[7].

In this multiple domain, hypoplasia were seen in right transverse, right sigmoid, right internal jugular vein and left transverse sinus in toto.

In subgroup analysis of our data into infant and children less than 12years, there is no significant difference in the pattern of hypoplasia of the dural venous sinus except hypoplasia of multiple sinuses which was predominantly seen in infant arm[10].



DISCUSSION

Cerebrovascular accident is a medical emergency condition. Cerebral venous thrombosis as a causative factor for cerebrovascular accident is under determined. Cerebral venous thrombosis in children are quite common due to high prevalence of dehydration, infection, trauma and other blood coagulation disorders[1] etc, in these vulnerable group. It's also often undiagnosed as venous stroke looks different from its arterial counterpart.

MR venography plays a pivotal role in the diagnosis of cerebral venous thrombosis in children as it precludes the use of radiation and contrast and in par with non invasive tool[5]. But there are few anatomic variations which interfere and acts as a pitfall[9] to arrive a precise diagnosis. These anatomic variations are to be borne in mind of reporting radiologist to prevent misdiagnosis.

As there is no much literature reference about the prevalence of anatomic variants that act as a pitfall in arriving a diagnosis of cerebral venous thrombosis in pediatric population[5], we designed this study.

This study was conducted in the department of radiodiagnosis, Institute of child health and hospital for children, Madras Medical College, Chennai. MR venography was done with Philips Achieva 1.5 Tesla MRI system. Phase contrast MRV which is gradient echo sequence with an addition bipolar gradient pulse were applied temporally between slice select and readout gradient[3]. This imaging is based upon the relative phase shift induced in the signal as blood moves along the direction of magnetic field compared to stationary background tissue. The recorded MR venography images of patients from January 2018 till June 2018 were taken for the study. After applying the strict exclusion criteria, 146 patients MRV images were taken for our study.

In our study, normal pattern of MR venography was seen 64.4% (n-94). Normal pattern of cerebral venous system was applied as follows. Superior sagittal sinus is seen as sickle shaped structure abutting inner table of the skull. Its variant includes absence of its anterior segment. The straight sinus is formed by junction of inferior sagittal sinus and vein of Galen[1]. Variance of straight sinus is rare[1]. It terminates by joining the superior sagittal sinus and transverse sinus to form venous sinus confluence. Venous sinus confluence is known as torcular herophili. It's usually asymmetric. Transverse sinus curves laterally from torcular to posterior petrous temporal bone where it turns inferiorly and form sigmoid sinus which

descends behind the petrous temporal bone and terminates as internal jugular vein[1]. Anatomic variations of transverse sinuses are the rule rather than exception[1].

The anatomic variant of MR venography not consistent with normal MR venography pattern was seen 35.6% (n-52). In this anatomic variant MR venography, most common variant in our study was hypoplasia left transverse sinus (48%)[6,7]. Next common variant noticed in our study is hypoplasia of right transverse and sigmoid sinus (21%). This reflects that right transverse sinus was dominant in children and co dominance of both transverse sinuses was seen in normal population. Right occipital sinus was seen 19% (n-10), which reflects the alternate pathway of venous drainage whenever there is hypoplasia of ipsilateral transverse sinus[7].

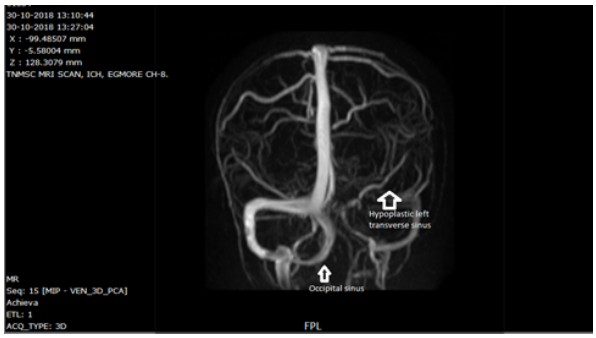


Figure 2. Coronal MRV image depicts hypoplastic left transverse sinus and the presence of occipital sinus

Apart from hypoplasia of single dural sinuses, hypoplasia involving multiple sinuses was also seen in our study population accounting about 11.5% (n-6).

In subgroup analysis of the study population as infant arm with age less than a year and children arm of age group from 1 year to 12 years of old, we could not able to see any difference in the pattern of anatomical variation of dural sinuses except hypoplasia of multiple sinuses were common in infant arm than in children arm[10].

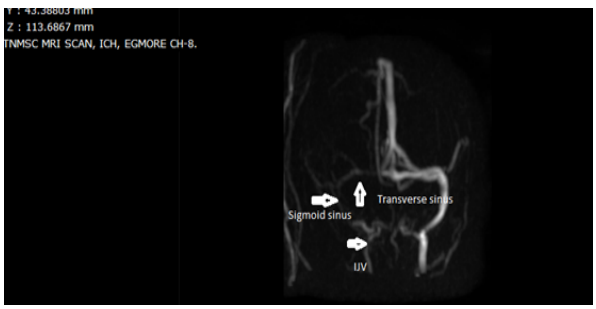


Figure 3. Coronal MRV image depicts hypoplasia of multiple sinuses

On comparing with the results of similar studies conducted in adult population, our study results are at par same as that of other studies. Our study is unique in that the population enrolled is focusing on pediatric population[1,10] who are at risk of cerebral venous thrombosis. In the text of Osborn's Brain Imaging, pathology and anatomy[1], commonest sinus variant is hypoplastic transverse sinus which is associated with alternate outflow pathway such as persistent occipital sinus. This same study result was seen in our study too. In another article published in the name of "Anatomic variants and artefacts in non enhanced MRV – potential pitfalls in diagnosing cerebral venous thrombosis "by Pallewatte et al in SLJR journal[8] in 2016. There results shows common hypoplasia is seen in left transverse sinus (39%) followed by right transverse sinus (10%). These results are comparable with our study results.

Limitations of this study are population enrolled in our study is small & study period is a short period of time. Anatomic variation was not confirmed with intravenous contrast medium and long term follow up was not carried out.

CONCLUSION

This study clearly explains the prevalence of anatomic variant of intracranial venous system in pediatric population which was not studied in detail earlier. Results of our study are comparable with the results of similar studies conducted at various places of the world. By analyzing the study reports, it is clear explicit that the reporting radiologist should be aware of the normal anatomy and its variants. Familiarity of this anatomical variant should be practiced well before coming to final conclusion thereby avoiding pitfalls[9] in the diagnosis of dural venous sinus thrombosis.

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