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MRV BRAIN NORMAL ANATOMICAL VARIANTS IN INDIA POPULATION

Radiodiagnosis

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ABSTRACT

Introduction: Knowledge of variations in the cerebral dural venous sinus anatomy seen on magnetic resonance (MR) venography is essential to avoid over-diagnosis of cerebral venous sinus thrombosis (CVST). Very limited data is available on gender difference of the cerebral dural venous sinus anatomy variations.

Materials And Methods: A retrospective study was conducted in NRI medical college in the Department of Radiodiagnosis for a duration of 3 years to study the normal anatomy of the intracranial venous system and its normal variation, as depicted by 3D MR venography, in normal adults and any gender-related differences.

Results: A total of (46 men, 54 women, age range 12 to 81 years), were included in the study. Most common indication for MR venography was headache (80%). Hypoplastic left transverse sinus was the most common anatomical variation in (25%) patients. Left transverse sinus was hypoplastic in more commonly in male in comparison to females (13 versus 12). Most common variation of superior sagittal sinus (SSS) was hypoplastic anterior one third SSS.

Conclusion: Hypoplastic left transverse sinus is the most common anatomical variation and more common in male compared to female in the present study. Other anatomical variations of dural venous sinuses are not significantly differ among both genders.

KEYWORDS

SSS- Superior Sagittal Sinus, ISS- Inferior Sagittal Sinus, SS- Stright Sinus, TS- Transverse Sinus, CS- Cavernous Sinus, SPS- Superior Petrosal Sinus, IPS- Inferior Petrosal Sinuses

INTRODUCTION

Normal Venous Anatomy:-

The intracranial venous system has two major components,the dural venous sinuses and the cerebral veins.

Dural venous sinuses

The dural venous sinus subdivided into anteroinferior group and posterosuperior group.

The posterosuperior group is the more prominent and consists of the superior sagittal sinus(SSS),inferior sagittal sinus(ISS),Straight sinus(SS),Sinus confluence (torcular herophili), Transverse sinuses(TSs),Sigmoid sinuses and Jugular bulbs.

The anteroinferior group consists of the cavernous sinus(CS),Superior and inferior petrosal sinuses(SPSs,IPSs),Clival venous plexus(CVP) and sphenoparietal sinus(SphPS).

Table-1 Classification Of Dural Venous Sinuses.

Posterosuperior group	Anteroinferior group
Superior sagittal sinus	Cavernous sinus
Inferior sagittal sinus	Superior petrosal sinuses
Straight sinus	inferior petrosal sinuses
Sinusconfluence(torcular herophili)	Clival venous plexus
Transverse sinuses	Sphenoparietal sinus
Sigmoid sinuses	
Jugular bulbs	

Superior Sagittal Sinus(SSS):

The superior sagittal sinus is a large curvilinear sinus that parallels the inner calvarial vault.it originates from ascending frontal veins anteriorly and runs in the midline at junction of the falx cerebri with the calvaria. Emissary and bridging veins connect the extracranial scalp veins with the SSS A number of so called “venous lakes” in the diploic spaces of the calvaria also drain into the SSS The SSS increases in diameter as it courses posteriorly collecting a number of unnamed small superficial cortical veins and the larger anastomotic vein of Troland[2].

Normal Variants:-

Most common variation of SSS was atresia of anterior one third SSS . Other variations were hypoplasia of the middle part of SSS ,hypoplasia of anterior one third of SSS, hypoplasia of anterior 2/3rd of SSS and hypoplasia of anterior half of SSS.

Inferior Sagittal Sinus(ISS):

Compared with the SSS,the ISS is a much smaller and more inconstant curvilinear channel that lies in the bottom of the falx cerebri.

The ISS lies above the Corpus callosum and Cingulate gyrus, collecting small tributaries as it curves posteriorly along the inferior free margin of the falx.The ISS terminates at the falcotentorial junction where it join with the great cerebral vein of Galen(VofG) to form the Straight sinus(SS)[1]

Normal Variants :-

Small or inappropriate ISS and are inconsistently visualized on imaging studies.

Straight Sinus(ss):

The straight sinus is formed by the junction of the ISS and VofG.it runs posteroinferiorly from its origin at the falcotentorial apex.

Normal Variants:-

Straight sinus variants are relatively uncommon,A persistent falcine sinus is an unusual variant that is identified on 2% of normal.The persistent falcine sinus will connect the ISS or VofG directly with the SSS.Two-thirds of patients with a persistent falcine sinus have absent/rudimentary SS[4].

Sinus Confluence:

The straight sinus terminates by joining the SSS and TSs to form the venous sinus confluence(torcular herophili).The venous sinus confluence is often asymmetric with septations and intersinus channels connecting the TSs.[4]

Transverse Sinuses(TS)

The Transverse sinuses also known as lateral sinuses,are contained between attachments of the tentorium cerebelli to the inner table of the skull.The TSs curve laterally from the torcular to the posterior border of the petrous temporal bone,where they turn inferiorly and become the sigmoid sinuses.[6]

Normal Variants:-

The two TSs are frequently asymmetric with the right side typically larger than the left.Hypoplastic or stenotic segments are present in one-third of the general population.Filling defects caused by arachnoid.

Sigmoid Sinuses:

The sigmoid sinus are basically the inferior continuations of the two

TSs.They fellow a gentle S-shaped curve,descending behind the petrous temporal bone to terminate by becoming the internal jugular veins(IJV),side-to-sides asymmetry of the sigmoid sinuses is common and normal.

Normal Variants :-
Right/Left sigmoid sinuses are hypoplastic or aplastic/atrectic, whereas bilateral sigmoid sinus are hypoplastic[5].

Jugular Bulbs:
The jugular bulbs are focal venous dilatations at the skull base between the sigmoid sinuses and IJVs.The IJVs provide the main venous outflow system of the brain.Alternative non jugular venous(NJV) pathways exist normally and may become important routes of collateral drainage in sinus thrombosis or intracranial hypertension.
The two major NJVs are the vertebral plexus and the pterygopalatine plexus.

There are concomitant variation in size of the jugular bulbs and their osseous foramina .Jugular bulb pseudolesions with flow asymmetry are common and should not be mistaken for real masses(e.g Schwannoma or paraganglioma)[5].

Cavernous Sinus:
The CSs are irregularly shaped heavily trabeculated/ compartmentalized venous sinuses that lie along the sides of the sella turcica extending from superior orbital fissure anteriorly to the clivus and petrous apex posteriorly.

The major tributaries draining into the CSs are the superior/inferior ophthalmic veins and the SphPSs. The two CSs communicate extensively with each other via intercavernous venous plexuses[8].

Superior and Inferior Petrosal Sinuses:
The SPS courses posterolaterally along the top of the petrous temporal bone, extending from the CS to the sigmoid sinus. The Inferior Petrosal sinuses courses just above the petro occipital fissure from the inferior aspect of the CVP to the jugular bulb.

Clival Venous Plexus:
The CVP is a network of interconnected venous channels that extends along the clivus from the dorsum sellae superiorly to the foramen magnum and it connects the CS and petrosal sinuses with each other and with the suboccipital veins around the foramen magnum[4].

Sphenoparietal Sinus:
The Sphenoparietal sinus courses around the lesser sphenoid wing at the rim of the middle cranial fossa. The SphPS receives superficial veins from the anterior temporal lobe and drains into the Cavernous sinus/ inferior petrosal sinus[5].

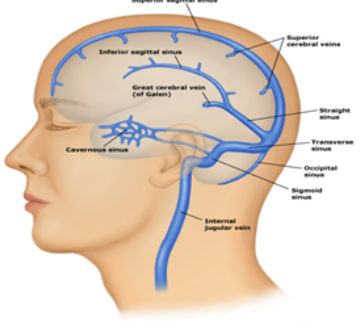


Fig-1 Normal Venous Anatomy Of Brain[25]

MATERIALS AND METHODS:-
Patients who were sent for MRV examination in NRI medical hospitals department of radio diagnosis from January 2018 to January 2020 were enrolled in this study. MRV data of 100 patients during study period was retrospectively reviewed.

Inclusion Criteria:
Patients with more than 12 years of age were included in this study.

Exclusion Criteria:
Patients with any congenital or acquired intracranial abnormality, venous thrombosis or previous surgery were excluded from the study.

A retrospective study was conducted to study the normal anatomy of the intracranial venous system and its normal variation, as depicted by 3D MR venography, in normal adults.MR imaging was performed with 1.5-T MR machine(GE healthcare) with standard head coil.

Three dimensional MR venography was performed in the coronal plane by using the following parameters:TE-50,TR-500,FOV-230-250,slice thickness 1mm,matrix-240x256,flip angle 50.additional rouine T2WI axial and FLAIR axial sequences were also performed.

Image Analysis:
Maximum intensity projections (MIPs) were created at the MR operating console for 3D-MR venography data set. The MIP images were viewed in the sagittal, transverse and coronal planes.

Source images from 3D MRV and MIP images were evaluated for anatomical variations of dural venous sinuses and presence of accessory sinuses. The dural venous sinuses included in this study are superior sagittal sinus, sigmoid sinus, transverse sinus, straight sinus and occipital sinus. The normal variations of transverse and sigmoid sinuses were noted. (symmetry, hypoplasia and aplasia or atresia).

The transverse sinuses were measured 1 cm from the Torcula heterophili and the sigmoid sinuses were measured 1 cm from the transverse sigmoid junctions. Their liner measurements were compared with the superior sagittal sinus.

If the linear measurement was less than half the size of the superior sagittal sinus, it was considered hypoplastic and if not visualised it was considered aplastic or atrectic sinus. The internal jugular veins were not included in the study.

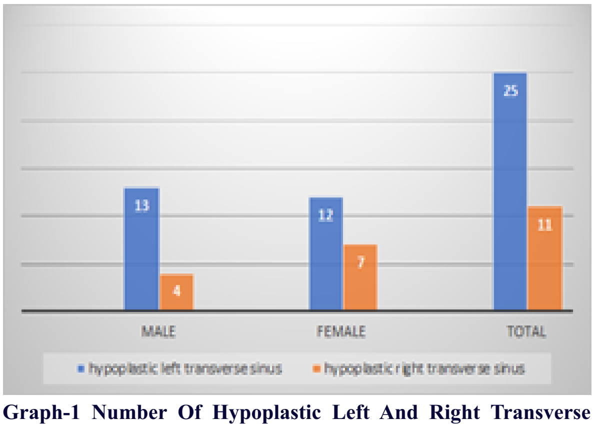
The presence of arachnoid granulations were recorded. AGs are defined as well-defined CSF-like signal intensity protuberances extending into the dural sinus commonly associated with adjacent entering cortical veins.

RESULTS
Our study included a total of 100patients (46 men, 54 women, age range 12 to 81 years, Most common indication for MRV was headache (80%). Other indications were headache and vertigo (10%), Seizure (3%), Headache and vomiting (3%), vertigo (3%), altered sensorium (1%)

Table-II Indications For Magnetic Resonance Venography

Indications	Male	Female
Headache	35	45
Seizure	2	1
Headache and vertigo	5	5
Headache and vomiting	2	1
Vertigo		3
Altered sensorium		1

Of the 100MR venograms obtained, 44 scans shows normal, the transverse sinus was found to be symmetrical in 35 patients. Left transverse sinus was hypoplastic in 25 and aplastic/atrectic in 10 cases. Right transverse sinus was hypoplastic in 11 and aplastic/atretic in zero patients. 1 cases had bilateral hypoplastic transverse sinuses.

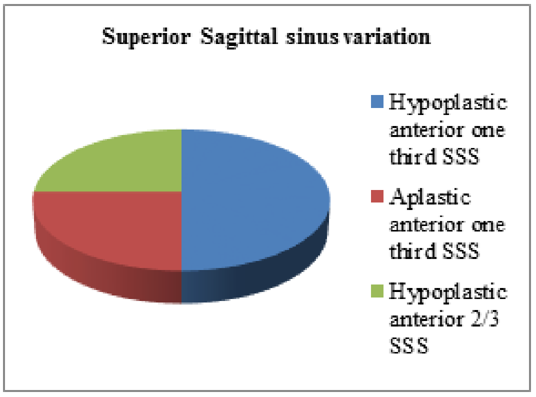


Graph-1 Number Of Hypoplastic Left And Right Transverse Sinus.

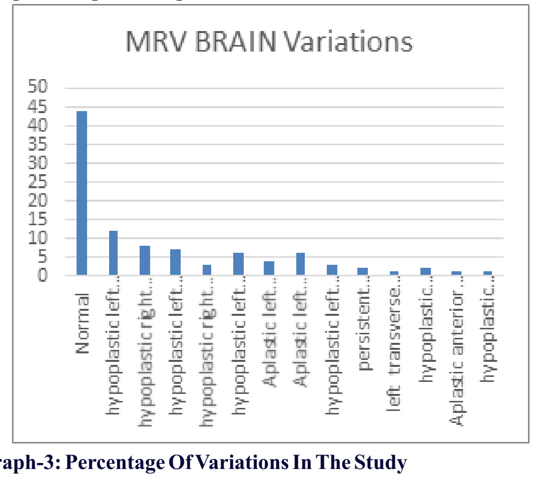
In comparison, female had significantly more symmetrical transverse sinus than male .Left transverse sinus was hypoplastic in more commonly in male in comparison to female (13 versus 12).

Out of 100,96 patients had normal superior sagittal sinus. Most common variation of SSS was hypoplastic anterior one third SSS (3%). Other variations were aplastic of anterior one third of SSS (1%), Other are hypoplasia of the middle part of SSS,hypoplasia of anterior 2/3rd of SSS and hypoplasia of anterior half of SSS which are not seen in present study.

There is no significant gender difference.



Graph-2 : Superior Sagittal Sinus Varirations



Graph-3: Percentage Of Variations In The Study

DISCUSSION

The study was conducted to evaluate the normal anatomical variations in intracranial venous sinuses in the Indian population. Most common indication to get MRV of the brain was headache in this study. Hypoplastic left transverse sinus was the most common anatomical variation, predominantly in male compared to female. Other anatomical variations of the transverse and sigmoid sinuses did not significantly differ among both genders. Hypoplasia of anterior one third of SSS was the most common variation of SSS, though not different among males and females.

Transverse sinus abnormalities were described by Gourav goyal et al[11]. Of the 1654 MR venograms obtained, the transverse sinus was found to be symmetrical in 1106 (66.9%) patients. Left transverse sinus was hypoplastic in 352 (21.3%) and aplastic/atrectic in 67 (4.1%) cases. Right transverse sinus was hypoplastic in 91 (5.5%) and aplastic/atrectic in 12 (0.7%) patients. 1.6% cases had bilateral hypoplastic transverse sinuses.

Transverse sinus abnormalities were described by Alper et al [12]. Symmetrical transverse sinuses were reported in 31%. Left transverse sinus was hypoplastic in 39% and aplastic in 20% of cases. Right transverse sinus was hypoplastic in 6% and aplastic in 4%. In other study of 100 patients, 10% had symmetrical transverse sinuses, 35% hypoplastic left transverse sinus, 13% hypoplastic right transverse sinus and 1% had aplastic left transverse sinus [13]. In contrast, our study showed symmetrical transverse sinus in 60 %, hypoplastic left transverse sinus in 25% and hypoplastic right transverse sinus in 11 %.

In the presence of complete hypoplastic rostral SSS, a pair of large parasagittal superior frontal cortical veins that run dorsally to join the origin of the SSS close to the coronal suture replace the absent rostral portion of the SSS [14,15].The most frequent SSS variation is the hypoplasia of rostral third of the SSS second only to preferential drainage of SSS to one of the transverse sinus [14,15]. Kaplan and Browder reported hypoplastic rostral SSS in 7 of 382 (1.8%) anatomic specimens in 1 series and in 12 of 201 (6%) specimens in a second anatomic series [14].

The occipital sinus, the smallest of the dural venous sinuses, which may be solitary, duplicated, or composed of a mesh of venous collaterals, is contained within the attached margin of the falx cerebelli and connects the torcula with the IJV[16].

Occipital sinuses were reported from 4 to 35.5% of cases in different studies [17,18,19,20]. In a study of 100 children, persistent occipital sinuses were seen in 13% of patients less than 25 months of age but in only 2% of children older than 5 years [21].

In our study, occipital sinus was identified in 3 % of the patients. Over reported incidence of the occipital sinus in the literature may be attributed to wrong interpretation of other venous structures as occipital sinus or ethnical differences of studied populations. Accurate information of the incidence of occipital sinuses can be accumulated by future autopsy series.

CONCLUSION

Knowledge of anatomical variations of cerebral dural venous sinuses is important. In the absence of this, flow gap in the venous sinus, hypoplasia and aplasia of the transverse sinus may be mistaken for venous sinus thrombosis. Hypoplastic left transverse sinus is the most common anatomical variation in the present study. Hypoplastic left transverse sinus is more common in male compared to female. Importance of male predominance of hypoplastic transverse sinus is not clear. Other anatomical variations of dural venous sinuses are not significantly differ among both genders.

Representative Cases:
Case 1:

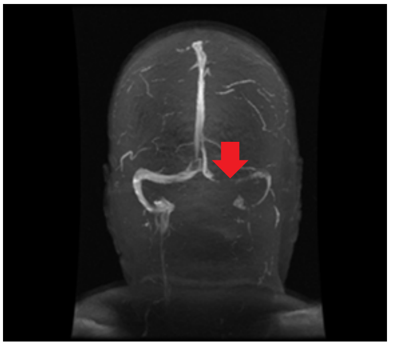


Fig 2: MRV Brain Shows Hypoplastic Left Transverse Sinus(➡)

Case2:

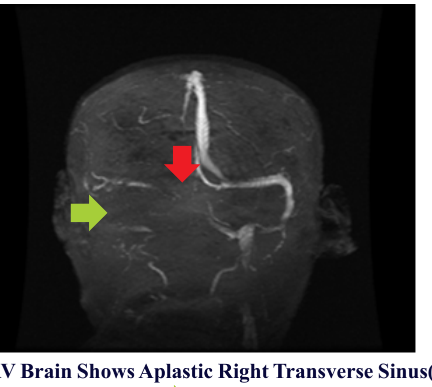


Fig3: MRV Brain Shows Aplastic Right Transverse Sinus(➡) And Hypoplasric Sigmoid Sinus(➡).

Case 3

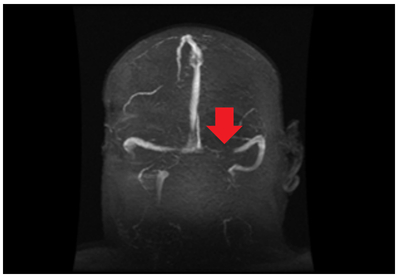


Fig4: MRV Brain Shows Aplastic Left Trasverse Sinus(➡)

Case 4

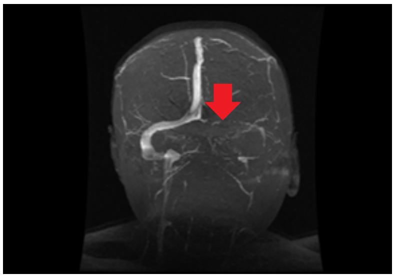


Fig 5: MRV Brain Shows Aplastic Left Transverse Sinus( ) And Sigmoid Sinus( )

Case 5

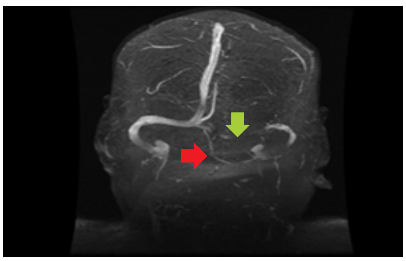


Fig 6: MRV Brain Shows Persistent Left Occipital Sinsus(➡)and Left Aplastic Transverse Sinus (➡)

Case 6

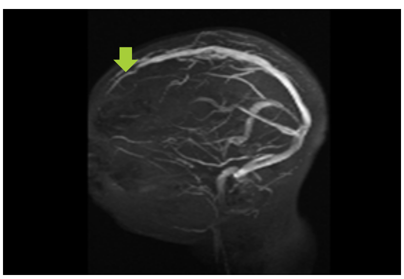


Fig 7: MRV Brain Shows Aplastic Anterior 1/3rd Of Superior Sagittal Sinus(➡).

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