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Drainage of Superior Sagittal Sinus And Handedness

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Abstract
Background and Objectives*: Determination of handedness is important in unidentified bodies. Drainage of Superior sagittal sinus (SSS) to one of the transverse sinuses is well documented. The present study is an attempt to find out any correlation between handedness and pattern of drainage of superior sagittal sinus.*
Materials and Methods*: In this study 100 cranial cavities from postmortem cases were utilised to assess the type of drainage of SSS and correlated with handedness. Handedness of cadaver was known through relatives.*
Results: *It was observed that amongst 97 right handed and 3 left handed subjects, four types of drainage patterns exist. Right dominant type was the commonest, noted in 45.4% of right handed subjects and 66.7% of left handed subjects. Bifurcation type was noted in 21.6% of right handed subjects and 33.3% in left handed subjects. Confluence type was noted in 17.5% of right handed subjects and nil in left handed subjects. Left dominant type was noted in 15.5% of right handed subjects and nil in left handed subjects. Pearson Chi- square test showed no correlation between types of drainage of SSS with handedness. Drainage was symmetrical to both transverse sinuses in 23.7% in right handed and 33.3% in left handed.*
Conclusion: *Neither handedness nor ethnicity had correlation with drainage of SSS. The study highlights pattern of drainage in right and left handed individuals and opens new vista of drainage of SSS in larger samples of left handed individuals.*
Keywords*: Superior sagittal sinus, drainage, handedness*

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I. Introduction

Superior sagittal sinus (SSS) is one of the dural venous sinuses that drain blood from the brain and cranial bones. It runs in the attached convex margin of falx cerebri and leaves a groove in the internal surface of frontal bone, the adjacent margins of the two parietal bones and occipital bone. Near the internal occipital protuberance it deviates, usually to the right, and continues as a transverse sinus (TS) and then continues as sigmoid sinus[1]. Handedness means individual preference of hand for performing tasks. Most individuals prefer use of right hand and prevalence of left handedness varies significantly between 2% and 3%.Earlier studies reported variation in drainage pattern of SSS. Right dominant type of drainage was the commonest[2,3,4]. Also, SSS does not drain equally to both the TSs. Unequal to absent transverse sinuses were also reported[5,6]Direct visual examination of occipital bone of a cadaver of known handedness and study of association of side of drainage of SSS with handedness is missing in academic literature. Here we investigated the type of drainage of SSS to the TS and if these are related to handedness. We hypothesise that the pattern of drainage of SSS to TS would be associated with handedness.

II. Materials And Methods

100 cranial cavities of autopsies done in the Department of Forensic Medicine, Regional Institute of Medical Sciences, Imphal from January to July 2017 were used as study material. Prior ethics approval was obtained from the Institutional Ethics Committee. Exclusion criteria of the subjects included damaged skull, injuries in early life resulting in recurrent seizures, anomaly of skull and unidentified bodies. Consent and handedness of the deceased was obtained from the lawful possessor of the cadaver. After removal of the calvaria, endosteal layer of dura mater covering the posterior cranial fossa was stripped away to expose the impressions of SSS and TS at the internal occipital protuberance. Visual as well as manual examination of SSS to its continuity as TS was done and they were categorised as right dominant, left dominant, confluence and bifurcation. Dominance was determined by the continuity of SS to TS. Symmetry of right and left transverse sinuses was also recorded by manual tracing of the groove for TS.Data were analysed using SPSS version 21. Percentages of types of drainage of SSS to TS was also determined.

III. Results

Our study included a total of 100 autopsy cases with known handedness. As only three cases were females sex categorisation was not done. Age ranged from 6 to 70 years. Out of 100 cases, 97 were right handed and 3 were left handed.

3.1 Types of drainage of SSS in right and left handed subjects

In right dominant type, SSS is continuous with the right TS. It was observed in 45.5% of right handed subjects and 66.7% of left handed subjects (Fig. 1). Left dominant type of drainage was observed in 15.5% of right handed subjects and no case in left handed subjects (Fig. 2). In confluence type, SSS though continuous either with right or left side had a connecting groove with the opposite TS at the internal occipital protuberance. It was observed in 17.5% of right handed subjects and no case in left handed subjects (Fig. 3). In bifurcation type, SSS divided at the internal occipital protuberance and each limb continuing with the corresponding TS. It was observed in 21.6% of right handed and 33.3% of left handed subjects (Fig. 4Amongst 100 subjects studied right dominant type accounted for 46% and hence was the commonest type of drainage of SSS irrespective of handedness. Bifurcation type, confluence type and left dominant type were observed in decreasing trend. Statistical analysis failed to show significant correlation between drainage of SSS and handedness (Table 1).

3.2 Symmetry of right and left transverse sinuses

Out of 97 right handed cases, 23 cases (23.7%) had symmetrical TSs. Right hypoplastic TS was observed in 24 cases (24.7%) and left hypoplastic TS was observed in 47 cases (48.4%). Left atretic TS was observed in 3 cases (3.09%) and atretic TS was not observed on right side. Out of 3 left handed cases, 2 cases of hypoplastic left TS and in the remaining one case TS was symmetrical (Table 2).

Table 1. Types Of Drainage Of Superior Sagittal Sinus And Handedness

Type of drainage	Handedness		Total
	Left	Right	
Right dominant (% within handedness)	2 (66.7%)	44 (45.4%)	46 (46%)
Left dominant (% within handedness)	0 (0.0%)	15 (15.5%)	15 (15%)
Confluence (% within handedness)	0 (0.0%)	17 (17.5%)	17 (17%)
Bifurcation (% within handedness)	1 (33.3%)	21 (21.6%)	22 (22%)
Total (% within handedness)	3 (100%)	97 (100%)	100 (100%)
Likelihood ratio =2.359 ; df =3 ; p=0.501			

Table 2: Size of transverse sinuses and handedness

	Symmetrical (n)	Hypolplastic right transverse sinus (n)	Hypoplastic left transverse sinus (n)	Atretic right transverse sinus (n)	Atretic left transverse sinus (n)
Left (3)	1	0	2	0	0
Right(97)	23	24	47	0	3
Total(100)	24	24	49	0	3

Figure 1. Right dominant type

Figure 2. Left dominant type

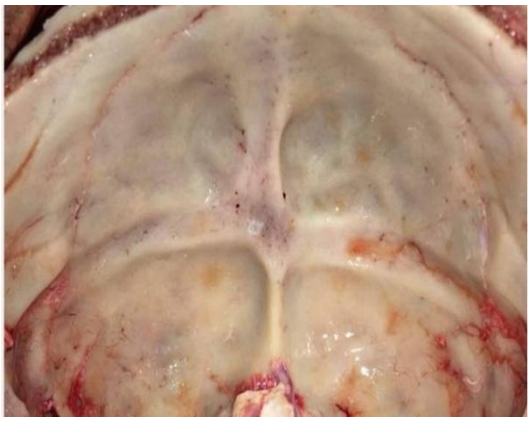

Figure 3. Confluence type

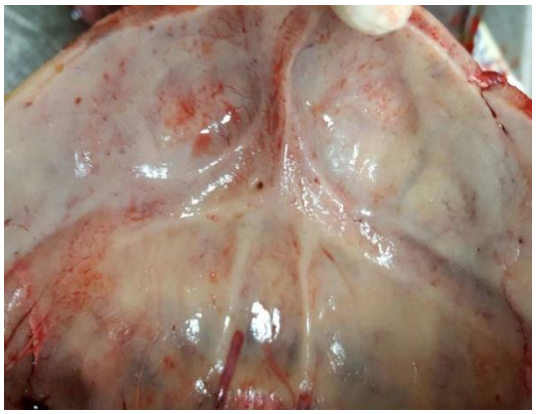

Figure 4. Bifurcation type

IV. Discussion

The study was conducted to evaluate the normal anatomical variations in the drainage of SSS in the north eastern Indian population. As we have scarcity of donated body after death, autopsy cases were utilised wherein handedness could be enquired from the relatives. Right dominant type of drainage of SSS was the commonest variant (45.5 %) and left dominance the least (15%). A study on 160 dried skulls also observed right dominant type (41%) as the commonest[2]. They observed bifurcation type in 14% whereas we observed in 22%. Confluence type was observed in 35% by them but we observed in 17% cases. Left dominant type was observed to be the least common type in their study (10%) which was also observed in the present study (15%) also. Earlier study in 110 cranial cavities categorised three types of variations of drainage of the SSS. Type 1 included SSS draining into one TS and the straight sinus into the other, with no connection between the two. Type 2 included the SSS and straight sinus fork and each fork form TS. Type 3 included a confluence of sinuses[7]. In a cadaveric study of 31 cases, SSS entered via the right TS in 51.6% and via the center of confluence of sinus in 45.2%. The SSS was divided and exhibited separate inflows to the right and left TS in one case only. The SSS draining to left TS was observed in one case only[3]. An angiographic study of 111 carotid angiograms also revealed the right dominance of SSS drainage to right TS in 61% and left dominance in 12.6%[8]. Even in the fetus, the SSS flowed mainly to right side and only 12.6% to the left[9]. Our study subjects who belong to people of Manipur and who belong to Mongoloid race, also observed a similar pattern of drainage. Previous studies were on different races and it appears that ethnicity plays no role in pattern of drainage of the SSS to TSs.

The SSS drains to one of the TS, equally to either of the TSs or forms a confluence with both the TSs. Hence the TSs are not usually symmetrical. A magnetic resonance venography reported symmetrical TS in 66.9%, left TS hypoplastic and atretic in 21.3% and 4.1% respectively and right hypoplastic and aplastic in 5.5% and 0.7% respectively[10]. Whereas in another MR venographic study, a higher left TS hypoplastic and aplastic (39% and 20% respectively) was observed. They observed symmetrical TSs in 31%. Right TS was hypoplastic in 6% and aplastc in 4%[11]. Yet another MR study reports higher hypoplastic left TS (35%). They observed 13% hypoplastic right transverse sinus, 10% symmetrical TS and 1% aplastic left TS[12]. In a cadaveric study of dural venous sinuses, symmetrical TSs was observed in 58.1%, right TS dominance in 35.5% and left

TS dominance in 3.2%[3]. In the present study, we observed a higher hypoplastic left TS in 49% as compared to symmetrical TS (24%) or hypoplastic right TS (24%). We also observed aplastic left TS in 3% among right handed subjects. This observance of higher hypoplastic left dominance is in accordance with dominant drainage pattern to right TS. We observed bifurcation type of drainage in 22% of subjects wherein the SSS equally drains to both TSs and hence, near equal cases of symmetrical TSs was observed. We observed slightly higher hypoplastic right TS (24%) in comparison with 15% of left dominant type of SSS drainage, the reason being inflow of straight sinus into the non-dominant TS leading to the larger TS. In left handed subjects, right dominant type of drainage of SSS was observed in two cases and therefore, the left TS was hypoplastic in both the cases. The lone case of bifurcation type of drainage of SSS showed symmetrical TSs. The present study highlights the relation between type of drainage of SSS and symmetry of transverse sinuses.

V. Conclusion

The present study observed four types of drainage of the SSS in right handed subjects namely right dominant, left dominant, bifurcation and confluence whereas in left handed subjects only two types namely, right dominant and bifurcation type were observed. Statistical analysis showed no relation between types of drainage of SSS with handedness. The reason being less number of left handed subjects as compared to the right handed subjects and is the major limitation of the present study. This study also highlights the relation between drainage pattern of SSS and symmetry of TSs. The study opens new vista for further study in left handed subjects.

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