Relation between cranial venous return and hand preference by magnetic resonance angiography

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ABSTRACT

Objective: This study was conducted to determine whether there is a relationship between hand preference and the site of cranial venous return. Magnetic resonance angiography was used for the determination of the site of dominance of cranial venous return.

Methods: Forty-seven right-handed and 45 left-handed subjects participated in the study conducted at the Sevgi Hospital in Ankara, Turkey between 1996 and 2000. The site of cranial venous return was determined by calibration of the superior jugular bulbus and named as right (R), left (L) and right-left (R-L). Calibrations of superior jugular bulbus were analyzed by one way variance analyses.

Results: There were statistically significant differences when analyzing the hand preference and calibration in the subjects with a venous return from the left, than from the right and right-left. The site of venous return (R, L, R-L) and venous calibration were analyzed by student t-test and were not statistically significant.

Conclusion: The venous return was from the left in right-handed subjects and from the right in left-handed subjects. Correlation's of hand preference and age and sex could not be made. For both-sided venous return, ambidexterity could not be determined.

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Lateralization is a vague notion. Much laterality, such as handwork, usage of hands, vision and hearing exist. The method that is most used to determine cerebral dominance of individuals is the measurement of the sensibility of the hands. These measurements include the hand preference, hand skills and familiar hand sensitivity. Moreover hand sensitivity was found to be related to other lateralizations, such as vision and audition, and it was often used in determining cerebral lateralization.[1] The aim of this study, in which magnetic resonance angiography (MRA) was used, is to search for a relationship between hand preference and site of cranial venous return. The motor characteristics of the right and left extremity show individuality. This asymmetry is not only peculiar to the extremity, but there is also lateralization related to vision, and hearing.[1] The measure of usage of hands includes the preference of hands used as a method of determining the cerebral dominance in healthy people. The majority of people prefer their right hand. For some researchers, it is seen in a study that cultural factors are also very important.[2,3] Some other researchers

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argue that handedness is related to genetics.[4,5] While other studies argue that left-handedness is seen more often in some clinical and psychological defects than right-handedness.[5,6] Tonnesen et al conducted a study to see if any relationship existed between learning difficulty, defects of immunity and left-handedness, and found out that 66.7% of the left-handed children with difficulties in learning had also defects of immunity, that 42.1% of the left-handed children with detects of immunity also had difficulties in learning, and that 32% of children with difficulties in learning and defects of immunity were left-handed. According to this study, among there 3 factors, handedness had the most important role.[7] The same was also argued for the mental defects.[5] The factor influencing the dominance of left-handedness can be related to cerebral pathology. Because of this cerebral pathology, the preference of the hands can be a consequence of left-handedness not of the hemisphere.[8,9] In a study of patients with unilateral brain disease, it was found that aphasic disorder was associated with lesions of the left hemisphere in left-handed patients with a dextral familial background, while a lesion in either hemisphere was likely to cause aphasic disorder in left-handed patients with a sinistra familial background.[10]

In light of the data on the existence of corpus callosum, it can be thought that not only the contralateral hemispheric functions but also the ipsilateral hemispheric functions are necessary for the performance of one hand.[5,11-13]

The usage of hands nowadays is examined under 2 groups; one which is formed of right-handed people and the other one which is formed of left-handed people. But, it is also possible to see a significant number of mixed handed people.[5]

Methods. This study included the participation of 47 right-handed and 45 left-handed subjects without any vascular pathology conducted at the Sevgi Hospital in Ankara, Turkey between 1996 and 2000 year. To overcome the difficulty of finding left-handed people, the left-handed ones are not chosen among the people attending the hospital, but rather they are recruited to come to the hospital for MRA. Among the right-handed subjects, 21 subjects were male and 26 subjects were female, and in the left-handed group 21 subjects were male and 24 subjects were female. There was no record of neuralgic or cerebral pathology or any cardiovascular disease in any of the subjects. A General Electric 1.5 T Signa Advantage system and 2D phase contrast sequence were used in the coronal plane, in the study. The field of view (FOV) was adapted individually (150-250 mm). The cranial venous return of the individuals was evaluated by the measurement of calibration of jugular bulbus and vein. The calibration of the internal jugular vein on the left and on the right is projected on the screen (**Figures 1, 2 and 3**). The measurements are taken where the internal jugular vein quits the jugular foramen and near the superior jugular bulbus. For some individuals, the site of venous return was from the right and for some others from the left. In some cases, the site was from both directions.

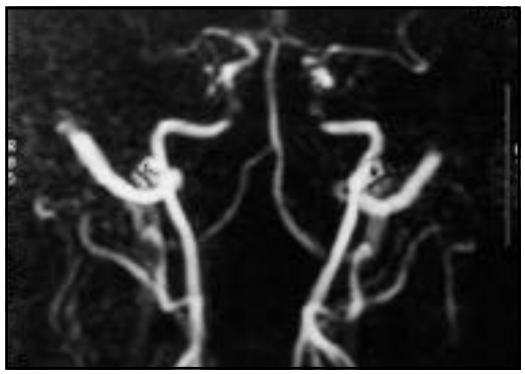

Figure 1 - The normal view of the site of left and right venous return on frontal plane in 2D PC MR.

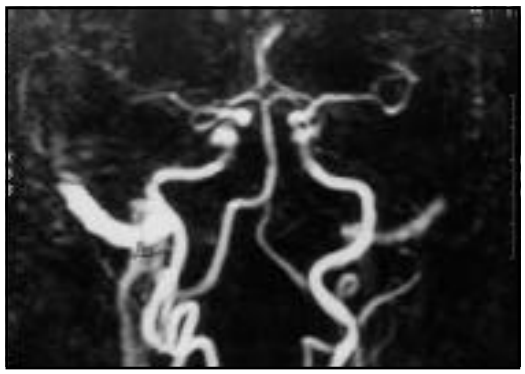

Figure 2 - The normal view of the site of right venous return on frontal plane in 2D PC MR.

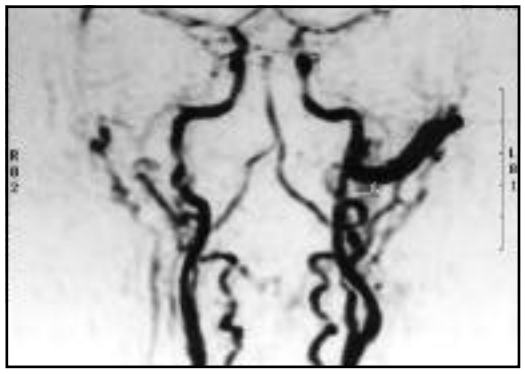

Figure 3 - The reverse view of the site of left venous return on frontal plane in 2D PC MR.

Table 1 - Numeral comparison of the site of the venous return of subjects according to their hand preference.

Hand preference	Left venous return	Right venous return	Left and right venous return	Total
Left-handed	5	31	9	45
Right-handed	28	7	12	47
Total	**33**	**38**	**21**	**92**

Table 2 - Distribution of site of venous return to sex.

Direction	Female	Male	Total
Left venous return	19	14	33
Right venous return	21	17	38
Left and right venous return	10	11	21
Total	**50**	**42**	**92**

Results. There was no age criterion in the study, and subjects varied from 21-56 years old. According to their sexes and their hand preference, the distribution of the individuals was 24 females and 21 males in the left-handed subjects, and 26 females and 21 males in right-handed subjects. By using the MRI films of the subjects, the site of their venous return was defined and similarly the diameters of their internal jugular veins were measured. The effect of the age on the site of venous return is determined by one way variance analysis. It was concluded that age has no effect on the site of venous return ($p>0.05$). The diameters of venous return whose site of return from right, left or both and hand-preferences were analyzed by one way variance analysis. There was a statistically significant difference among their measurements ($p<0.05$). Generally, individuals with venous returns from the left were right-handed and those with venous returns from the right were left-handed. No significant difference existed after the analysis of the individuals with venous return from the left, from the right and from the both directions. The diameters of superior jugular bulbus on the left and on the right were measured as 7.5±0.323 mm venous diameter of left venous return, 7.6±0.336 mm venous diameter of right venous return and 7.3±0.34-6.5±0.4 mm venous diameter of left and right venous return. Venous return site (R, L, R-L) was compared by student t-test. According to this test, there was no statistical difference between the diameters and venous return site. The venous return site and hand preference and their distribution according to the sex of the subjects is given in **Tables 1 and 2**. There was no significant relationship between the sexes and the hand preference.

Discussion. The asymmetry between the 2 cerebral hemispheres and the lateralization due to this asymmetry had been searched by various radiological methods such as angiography, ultrasonography, computed tomography and magnetic resonance imaging.[14] In some studies handedness has been used as a technique to infer cerebral language dominance because of the correlation between language and hand preference.[15] The oxygen and the nutrients that the brain needs to continue its activity are provided via the vertebral artery and carotid artery.[16,17] The brain always needs a flow of blood and this is continuous along internal carotid arteries via systole and diastole.[18] The turning of the venous blood of the brain is secured by the left and right internal jugular veins.[16,17] According to research conducted by Bogren et al,[18] the flow of blood on the right and on the left in the feeding of brain is different.[18] The relationship between this case and the usage of hands is like the relationship between the turning of the venous blood and the lateralization in this study. Bogren and his friends, to compare the current proportions of the patients who had an internal carotid artery stenosis brought these proportions to a standard level by MR speed search. By doing this, they aimed at determining the normal current proportions of the patients who use their left or right hand dominantly. To this end, they measured the current of blood of internal carotid artery and vertebral artery of 5 right-handed and 5 left-handed and 2 mixed handed people. In all right-handed cases, left internal carotid arteries had higher ratios of the current then the right one. Likely, for all the left-handed people right internal carotid arteries had higher proportion of the current of blood. For the individuals using both their left and right hands, there was no significant difference between the proportions of current of left and right common carotid artery.[18]

What is important in this study is that the individual whose site of venous return from the right or from the left are different from each other. Usually the subjects whose venous return site is from the left are right-handed, and whose venous return site is from the right are left-handed, for the venous return site from both sites, there was no usage of both hands. But some studies explain that in cases in which there is left and right arterial feeding of the cerebral hemispheres, this influences the usage of the right and left hands.[18] In cases in which there is no dominant hemisphere, the counterpart becomes dominant and determines the usage of hands.[19,20] In Pujol's study[21] it was comparable with Rasmussen and Milner's[22] that 76% of left handers showed predominant functional MRI changes in the left hemisphere.

In this study the findings also state that although some individuals had venous returning to the left were left-handed, some people having venous return from the right were right-handed and some people having venous return from the right and left were using their left and right hands. These latest examples are in contradiction with the traditional approach about the effect of the lateralization on the dominant hemisphere and the usage of hands. Kawashima et al[20] studied the regional cerebral blood flow (rCBF) with positron emission tomography in 10 normal right-handed. This study showed that rCBF changes in the motor area and the prefrontal area of one hemisphere are not related simply to movement of the contralateral hand.[20] In Loring's study[15] MRI results show that the hemispheric lateralization of language activation is correlated with lateralization of right-hand motor activity.[15] Hanna-Pladdy et al[23] found that the degree of hemispheric specialization is, in part, dependent upon the nature of the motor task, with left hemisphere motor control necessary for tasks that require precision and coordinated independent finger movements. In our study R, L and R-L diameters are not significantly different (p>0.05), and in persons with both sided venous return the diameters of superior jugular bulbus are not significantly different (p>0.05). Henderson et al[3] compared CT measure of the left and right hemispheres for 2 groups of right handed adults: Those who were left hemispheric language dominant (n=89) and those who were right hemispheric language dominant (n=16). The distribution of linear CT measures of anterior and posterior widths and lengths did not differ significantly in the 2 groups.[3] These findings to support the CT criteria of hemisphere asymmetry predict language laterality.[3,24] Some researchers concluded that sex could be related to brain asymmetry.[14] Same researchers say that left-handedness is seen predominantly in families.[14,25] Some authors suggest that exclusive right cerebral language representation is rare and that in the absence of clear left-hemisphere dominance, most left-handed people have some degree of bilateral representation. In our study we did not find any significant difference between hand preference and sex (p>0.05). Also, the age is not related to the side of the venous return, and with the preference of the hands (p>0.05). Other authors have also claimed that hand-preference is genetically transmitted.[2,26,27] Tan,[25] in his study concluded that the right hand (left brain) determines left-handedness, the neural structures only on the left side exhibit pronounced plastic changes to genetic and environmental influences in left-handers. Some researchers emphasized the leading role of left hemisphere in cognitive functions such as language and mental arithmetic and concluded that the left hemisphere is dominant for language and found in the vast majority of left-handers.[25]

In this study we tried to establish the relationship between hand preference and venous return side. Brain asymmetry and the asymmetry causing lateralization, especially hand preference is important. Because hand preference is related to higher cerebral functions, it is that basic subject of asymmetry research. Amunts et al[28] said that anatomical asymmetry was associated with handedness only in males, but not in females, suggesting sex differences in the cortical organization of hand movements.

In conclusion, we found that cranial venous return is related with the hand-preference. Individuals with venous return from the left were right-handed and those with venous return from the right were left-handed. Ambidextrous individuals may be right or left handed, sex and age is not related with side of venous return, or with the hand preference. Cerebral functional laterality determined by in vivo anatomical measures can be used to aid brain surgery, and as a pragmatic in recovery from brain damage.[1] We could not study the venous flow rate, because of the need for another MRI protocol for measuring different slices. However, our study may lead to new studies in larger series in the future. Increasing the number of subjects may help to understand better why left-handed subjects venous return is from the left in our study. Decrease in the cerebral blood flow causes distortion of neuralgic, mental and also vital functions. Research on the lateralization may help clinicians with diagnosis and treatment. In the human brain, activity is much more in the dominant hemisphere than the non-dominant hemisphere.[18]

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