

## **An Anatomical study of the circle of Willis in a Sri Lankan population**

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Abstract:

A knowledge of the normal anatomical patterns and the incidence of variations in the circle of Willis are essential in order to appreciate the variations of the 'circle' which predispose to vascular disease in the brain. The present study was conducted to determine the vascular pattern of the circle of Willis in a Sri Lankan population its normal configuration, the incidence of complete and incomplete 'circles' and to correlate such variations with clinical findings. A comparison of the configurations of adult and foetal brains was carried out and the changes during foetal development were assessed. The diameters of the 'circle' within populations were also compared and the degree of narrowing of the arterial lumen due to atherosclerosis and the incidence of aneurysms in the 'circle' were studied. In the main study, the anatomical variations of 259 cadaver brains (225 adults and 34 fetuses) were studied following a pilot study of 71 brains. Luminal diameters of each segment of the circle were measured with a micrometer-calibrator. Arteries of less than 1 mm in diameter were considered abnormal. The degree of narrowing of the vessels of the circle was assessed. The present study is the only single large study known, where all the diameters of the component vessels of the circle of Willis were actually measured and all known anomalies were documented. The compensatory capacity of the circle of Willis depends on anastomosis, which is a function of the diameter of the arteries forming the 'circle'. In this study the average diameters of cerebral arteries were the smallest in Sri Lankans, when compared with South Indian and Japanese populations. The 'typical circle' was observed in only 14.2 percent of the 'circle' while 85.77 percent were hypoplastic 'circle'; the highest recorded in the literature. It was noted that a single anomaly in a component vessel was associated more with multiple anomalies of other vessels. These findings were clinically significant in the aetiology of cerebrovascular accidents, as variations may be considered as contributory factors for the higher incidence of cerebrovascular accidents in young Sri Lankans. The incidence of variations ( $X^2 = 1738.56$ ,  $p < 0.001$ ), and the location of hypoplastic stems ( $X^2 = 58.85$ ,  $p$

<0.005) in the 'circle' among populations is not uniform. Fifteen configurations of variations in the arterial system were observed and classified by Riggs and Rupp. (Fig. 1) In the present study, seven additional patterns were observed (Fig. 2). Therefore incidence of variations in the 'circle' in Western or Asian populations cannot be extrapolated to Sri Lankans. Sri Lankans have the highest percentage (93.3 percent) of the adult configuration ( $\chi^2 = 84.6053, p < 0.0001$ ), in which the occipital lobe receives its blood supply from the vertebrobasilar system. The transition of the blood supply to the occipital lobe from the carotid to the vertebrobasilar circulation occurs at 30 - 40 weeks of gestation. ( $\chi^2 1.12 p < 0.05$ ) and the commonest site of an anomaly is in the posterior half of the circle. The incidence of aneurysms in Sri Lanka is much lower when compared to its incidence in other parts of the world. The narrowing of a major arterial lumen by 50 percent or more in the major arteries of the 'circle' due to atherosclerosis was not detected.