



COMPARATIVE STUDY OF CEREBRAL ARTERIAL LUMEN NARROWING DUE TO ATHEROSCLEROSIS IN SUICIDAL AND NON-SUICIDAL DEATHS.

Forensic Medicine

Dr. Vidhu Prabhakar*

Assistant Professor, Forensic Medicine, AIIMS CAPFIMS Centre, Maidan Garhi.
*Corresponding Author

Dr. Krishna Kumar. S

Associate Professor, Forensic Medicine, Govt. Medical College, Wayanad, Kerala.

Dr. Shali A.S

Associate Professor, Pathology, Govt. Medical College, Wayanad, Kerala.

ABSTRACT

Suicide, a multifaceted and pressing public health issue of global significance, is responsible for a substantial loss of life across the world. Its pervasive impact demands the focused attention of researchers, healthcare professionals, policymakers, and society as a whole. It is well-documented that cerebrovascular diseases can contribute to the development of depressive disorders, which, in turn, may serve as a significant risk factor for suicidal behavior. Objective of this study is to compare the atherosclerotic lumen narrowing status of cerebral arteries in cases of suicidal deaths and non-suicidal deaths in the age group 40 years and above. The incidence and severity of lumen narrowing was more marked in all the intracranial arteries of subjects of suicide group compared to that of subjects in the non-suicide group. The association between suicide and atherosclerotic lumen narrowing of arteries of cerebral blood supply were found to be statistically significant. The intricate relationship between cerebrovascular health and mental well-being underscores the need for a comprehensive, collaborative approach to addressing this issue.

KEYWORDS

Suicide, Intracranial atherosclerosis, Cerebrovascular disease, Suicide prevention

INTRODUCTION

Suicide is considered as a psychiatric emergency. Globally, an estimated 11-14 suicides per 100 000 people occur per year, resulting in 804000 deaths (1). Given the sensitive nature of suicide and its legal implications in certain countries, it is highly probable that instances of suicide are under-reported. The stigma surrounding suicide, along with the fear of legal consequences, often discourages accurate reporting and open discussion. Additionally, suicide is rarely the result of a single factor. Instead, it is influenced by a complex interplay of social, psychological, cultural, and environmental elements, all of which can contribute to an individual's decision to engage in suicidal behavior. Understanding the multifaceted causes of suicide is essential for developing effective prevention strategies and providing comprehensive support to at-risk individuals. Psychological autopsies from the middle of the previous century and onwards have revealed that most people who have died by suicide have suffered from mental disorders (2). Depressive syndromes can be caused by a variety of medical disorders. Cerebrovascular disorders constitute a major cause. Atherosclerosis is the most common cause of cerebrovascular diseases (3). Objective of the study was to compare the atherosclerotic lumen narrowing of cerebral arteries in cases of suicidal deaths and non-suicidal deaths in subjects aged 40 years and above.

MATERIALS AND METHODS

This was a cross-sectional comparative study conducted at Department of Forensic Medicine at Government Medical College, Kozhikode. The duration of study was one and a half years. Subjects were selected according to inclusion and exclusion criteria. Sample size was calculated using the study titled "Pattern of Cerebral Atherosclerosis in Hong Kong Chinese-Severity in Intracranial and Extracranial Vessels" conducted by Leung SY et.al (4). Inclusion criteria for suicide group was 'cases with history and the postmortem findings being consistent with suicide' & for non-suicide group was 'cases with history of death following some diseases, accident or homicide.' Exclusion criteria for both groups was 'cases of advanced decomposition, death due to coronary artery disease or stroke and cases in which the cerebral arterial circulation is severely damaged due to trauma.'

In all the study subjects, cerebral arterial circulation was examined by gross examination to make an initial assessment of the presence and extent of the morphological changes due to atherosclerosis. Samples were taken from the basilar artery and terminal segments of internal carotid arteries of both sides and were fixed overnight in 10% formalin, then processed in automatic processing unit and stained with hematoxylin-eosin stain and then examined under microscope for atherosclerotic changes. Artery segments without any gross or microscopic findings of atherosclerosis were considered as normal. In

every artery segment with atherosclerotic changes, the lumen narrowing was assessed. For this purpose the histology slides with cross section of arteries were photographed using a Leica DM750 microscope with 'LASEZ' software and uploaded in Adobe Photoshop CC 2017 and with the help of 'scale' and 'measurement' tools, the lumen narrowing was assessed. Data were entered in Microsoft Excel 2013 and analyzed using Statistical Package for the Social Sciences (SPSS) software version.25. Pearson's Chi-square test was done and p value < 0.05 was taken as significant.

Ethical Concerns: Approval from the institutional ethical committee was obtained. Informed written consent was obtained from the relatives of the study subjects. Confidentiality regarding the details of the deceased will be maintained.

RESULTS

Study group included 172 cases with age more than 40 years. Mean age of the study group was 56.95 with standard deviation of 10.62. Mean age of the study subjects in the non-suicide category (86 cases) was 56.67. Mean age of the study subjects in the suicide category (86 cases) was 57.22. In the suicide group 23 were females (26.7%) and 63 were males (73.3%). In the non-suicide group 20 were females (23.3%) and 66 were males (76.7%). Percentage of lumen narrowing noted in the respective artery segments are given in tables 1 to 3.

Table 1- Lumen Narrowing Of Basilar Artery Among Study Subjects

Occluded Lumen in percentage	Category		Total
	Non-suicide	Suicide	
Nil	60	23	83
< 20 %	26	27	53
21-40 %	0	21	21
41-60 %	0	14	14
61-80 %	0	1	1

Table 2 - Lumen Narrowing Of Left Internal Carotid Artery Among Study Subjects

Occluded Lumen in percentage	Category		Total
	Non-suicide	Suicide	
Nil	73	27	100
< 20 %	12	31	43
21-40 %	1	14	15
41-60 %	0	11	11
61-80 %	0	3	3

Table 3 – Lumen Narrowing Of Right Internal Carotid Artery Among Study Subjects

Occluded Lumen in percentage	Category		Total
	Non-suicide	Suicide	
Nil	75	24	99
< 20 %	10	34	44
21-40 %	1	14	15
41-60 %	0	12	12
61-80 %	0	2	2

63 cases in the suicide group (73.3%) showed lumen narrowing of basilar artery compared to 26 cases in the non-suicide group (30.2%). Increased number of subjects with significant lumen narrowing of basilar artery were found in the suicide group compared to non-suicide group. This was found to be statistically significant with p value < 0.05 and χ^2 value = 31.876). 59 cases in the suicide group (68.6%) showed lumen narrowing of left internal carotid artery compared to 13 cases in the non-suicide group (15.1%). Increased number of subjects with significant lumen narrowing of left internal carotid artery were found in the suicide group compared to non-suicide group. This was found to be statistically significant with p value < 0.05 and χ^2 value = 50.549. 62 cases in the suicide group (72.1%) showed lumen narrowing of right internal carotid artery compared to 11 cases in the non-suicide group (12.8%). Increased number of subjects with significant lumen narrowing of right internal carotid artery were found in the suicide group compared to non-suicide group. This was found to be statistically significant with p value < 0.05 and χ^2 value = 61.903.

DISCUSSION

Vascular depression hypothesis suggests that the structural alterations in the brain caused by atherosclerosis play a central role in the development of depression in later life. These changes are believed to disrupt normal brain function, leading to the onset of depressive symptoms in individuals affected by cerebrovascular conditions (5) (6). The vascular depression hypothesis is mainly supported by neuroimaging studies, which demonstrated hyper-intensities (7). As there is an association between cerebrovascular diseases and depression, the suicide risk in these cases warrants evaluation.

Increased incidence of intracranial atherosclerosis with increasing age have been documented in previous studies. The population-based Rotterdam study conducted by Bos . D et al. has evaluated the prevalence of intracranial internal carotid artery calcification, a marker of intracranial atherosclerosis which was observed in over 80% of older, white subjects (8). A transcranial Doppler study conducted by Wong et al. showed that the prevalence of asymptomatic middle cerebral artery stenosis ranged from 7.2%-30% among Asian patients who had vascular risk factors without a history of stroke or TIA (9). Intracranial atherosclerotic disease is more prevalent in Asians than in Westerners; the reason for this is unknown. Possible explanations include inherited susceptibility of intracranial vessels to atherosclerosis, acquired differences in the prevalence of risk factors, and differential responses to the same risk factors. Lifestyle may also play a role in the racial-ethnic differences (10).

Considering the above facts, the possibility of atherosclerosis of the arteries of cerebral blood supply causing vascular depression and its psychiatric manifestations will be an important factor in many of the suicides involving people of adult and old age. The findings of present study reveal a statistically significant positive correlation between the degree of cerebral arterial lumen narrowing due to atherosclerosis and deaths classified as suicidal, as compared to non-suicidal deaths. This observation suggests that atherosclerosis in the cerebral vasculature may play a more pronounced role in individuals who die by suicide. While the precise mechanisms underlying this association remain speculative at this stage, the results align with emerging evidence linking vascular pathology to neuropsychiatric outcomes, including mood disorders and suicidal behaviour. Atherosclerosis of arteries of circle of Willis in 51 suicide cases was evaluated by Sreenivas SC in the Kannur district of Kerala in his autopsy-based study and found out that during 40 years to 50 years of age only fatty streaks were recorded in the circle of Willis. As the age advances further, atheroma and calcification were seen (11). Comparison with a non-suicide group was not done in his study.

Considering the age of onset and incidence of intracranial atherosclerosis, findings of present study was in correlation with the autopsy-based study conducted by Nakamura.M et al. in Japanese population, in which cerebral atherosclerosis appeared as early as the second decade and increased in severity with age particularly in the

fifth decade in males and sixth decade in females. The internal carotid artery was the least commonly involved. They also observed significant difference in onset and progression of cerebral atherosclerosis in males and females. In females the frequency and intensity of atherosclerosis were low up to the fifth decade compared to males, but was very steep after the sixth decade, becoming equal to those of males (12). Yang et al. in their autopsy based study exploring distribution and patterns of intracranial artery calcification stated that 'cases with intimal calcification were older than those without calcification' (13).

Autopsy based studies of human coronary arteries by Glagov et al. in 135 subjects showed that there is an adaptive response occurring in arteries with plaque formation which results in enlargement of artery to prevent lumen stenosis, which was delayed until the plaque occupies 40% of total lumen area (14). Similar findings were recorded by Zarins et al. where they observed that, In the most severely diseased distal LAD artery sections, despite a fourteen fold increase in the plaque area, lumen area almost doubled because of a marked increase in artery size (15). This was termed as positive remodeling (16). Similar studies were later done in intracranial arteries to assess the validity of the hypothesis that outward remodeling in systemic arteries is a compensatory mechanism for lumen area preservation in the face of increasing arterial stenosis. Gutierrez et al. conducted study in 196 autopsied subjects with a mean age of 55 years and found out that, arterial lumen decreases proportionally to the degree of stenosis in the large intracranial arteries and the smaller brain arteries might in fact shrink with growing stenosis (17). In our study also increased size of atherosclerotic plaque was associated with decrease in the patency of lumen in all the artery segments. There were no previous studies available which compares the atherosclerotic lumen narrowing of cerebral arteries in people committing suicide and people dying due to other causes.

CONCLUSIONS

In conclusion, the study observed a significantly greater incidence and severity of lumen narrowing in all intracranial arteries of individuals in the suicide group when compared to those in the non-suicide group. However, no cases of complete occlusion of the intracranial arteries were identified among the subjects. Suicidal behavior is predominantly multifactorial in nature, with impulsivity often playing a key role. Many suicide attempts occur without the presence of clear psychiatric disorders or premeditated intentions, unlike in planned suicides. The history provided by relatives and investigating officers in this study was insufficient to thoroughly capture details regarding past psychiatric conditions or prior suicidal ideations, which could have influenced the findings. Future research should involve larger sample sizes, conducted across various regions, and incorporate random sampling techniques. This approach will help mitigate confounding factors and reduce selection bias, allowing for more robust conclusions regarding the relationship between intracranial arterial atherosclerosis and suicide.

Funding – Nil

Conflict Of Interests - Nil

REFERENCES

1. Turecki, G., & Brent, D. A. (2016). Suicide and suicidal behaviour. *The Lancet*, 387(10024), 1227–1239.
2. Robins, E., Murphy, G. E., Wilkinson, R. H., Gassner, S., & Kayes, J. (1959). Some clinical considerations in the prevention of suicide based on a study of 134 successful suicides. *American Journal of Public Health and the Nation's Health*, 49(7), 888–899.
3. Sadock, B. J., & Sadock, V. A. (2000). Kaplan and Sadock's comprehensive textbook of psychiatry (7th ed., Vol. 1, p. 813). Lippincott Williams & Wilkins.
4. Leung, S. Y., Ng, T. H., Yuen, S. T., Lau, I. J., & Ho, F. C. (1993). Pattern of cerebral atherosclerosis in Hong Kong Chinese: Severity in intracranial and extracranial vessels. *Stroke*, 24(6), 779–786.
5. Alexopoulos, G. S., Bruce, M. L., Silbersweig, D., Kalayam, B., & Stern, E. (1999). Vascular depression: A new view of late-onset depression. *Dialogues in Clinical Neuroscience*, 1(2), 68–80.
6. Krishnan, K. R., & McDonald, W. M. (1995). Arteriosclerotic depression. *Medical Hypotheses*, 44(2), 111–115.
7. Tiemeier, H., van Dijk, W., Hofman, A., Witteman, J. C. M., Stijnen, T., & Breteler, M. B. (2004). Relationship between atherosclerosis and late-life depression: The Rotterdam Study. *Archives of General Psychiatry*, 61(4), 369–376.
8. Bos, D., van der Rijk, M. J. M., Geeraedts, T. E. A., Hofman, A., Krestin, G. P., Witteman, J. C. M., et al. (2012). Intracranial carotid artery atherosclerosis: Prevalence and risk factors in the general population. *Stroke*, 43(7), 1878–1884.
9. Wong, K. S., Ng, P. W., Tang, A., Liu, R., Yeung, V., & Tomlinson, B. (2007). Prevalence of asymptomatic intracranial atherosclerosis in high-risk patients. *Neurology*, 68(23), 2035–2038.
10. Bang, O. Y. (2014). Intracranial atherosclerosis: Current understanding and perspectives. *Journal of Stroke*, 16(1), 27–35.
11. Sreenivas, S. (2016). Study of atherosclerotic changes of arteries of Circle of Willis in suicide – A retrospective autopsy-based study. *Medico-Legal Update*, 16(2), 225–229.

12. Nakamura, M., Yamamoto, H., Kikuchi, Y., Ishihara, Y., & Sata, T. (1971). Cerebral atherosclerosis in Japanese: I. Age related to atherosclerosis. *Stroke*, 2(4), 400–408.
13. Yang, W. J., Zheng, L., Wu, X. H., Huang, Z. Q., Niu, C. B., Zhao, H. L., et al. (2018). Postmortem study exploring distribution and patterns of intracranial artery calcification. *Stroke*, 49(11), 2767–2769.
14. Glagov, S., Weisenberg, E., Zarins, C. K., Stankunavicius, R., & Kolettis, G. J. (1987). Compensatory enlargement of human atherosclerotic coronary arteries. *The New England Journal of Medicine*, 316(22), 1371–1375.
15. Zarins, C. K., Weisenberg, E., Kolettis, G., Stankunavicius, R., & Glagov, S. (1988). Differential enlargement of artery segments in response to enlarging atherosclerotic plaques. *Journal of Vascular Surgery*, 7(3), 386–394.
16. Schoenhagen, P., Ziada, K. M., Vince, D. G., Nissen, S. E., & Tuzcu, M. E. (2001). Arterial remodeling and coronary artery disease: The concept of “dilated” versus “obstructive” coronary atherosclerosis. *Journal of the American College of Cardiology*, 38(2), 297–306.
17. Gutierrez, J., Goldman, J., Honig, L. S., Elkind, M. S., Morgello, S., & Marshall, R. S. (2014). Determinants of cerebrovascular remodeling: Do large brain arteries accommodate stenosis? *Atherosclerosis*, 235(2), 371–379.