Original Research Paper

Medicine

A PROSPECTIVE STUDY ON BLOOD PRESSURE AND SERUM LIPID PROFILE IN STROKE PATIENTS ADMITTED IN R.G.KAR MEDICAL COLLEGE AND HOSPITAL

Dr. Partha Pratim Dey | Tutor, General Medicine, R. G. KAR Medical College And Hospital

Dr. Debarshi Jana* | Institute Of Post-graduate Medical Education And Research, A.J.C. Bose Road, Kolkata. *Corresponding Author

ABSTRACT
High Blood pressure and High lipid level, both can be modify through change in lifestyle. It is estimated that 70% of strokes are potentially preventable by lifestyle modification but prospective evidence is needed to support these hypotheses derived from epidemiological studies.

Aim of our study to compare the Lipid Profile patterns between acute ischemic and acute hemorrhagic stroke patients.

Present study was conducted in the department of General Medicine in R.G.Kar Medical College & Hospital, West Bengal. 100 patients were selected using above defined criteria, 50 patients had in acute ischemic stroke and 50 patients had in acute haemorrhegic stroke. Present study was conducted from July 2018 to June 2019.

We found that total cholesterol, Triglyceride, LDL, VLDL and HDL influenced the significant risk of developing an ischemic stroke. Low HDL – cholesterol is also significantly more prevalent in ischemic CVA group in our study. Findings suggested that ischemic stroke patients had higher serum total cholesterol and lower HDL- cholesterol levels in comparison to hemorrhagic stroke. Systolic Blood Pressure and Diastolic Blood Pressure were significantly associated with haemorrhagic stroke.

Dyslipidemia is associated with both types of stroke. However hyper cholesterolemia is significantly more associated with ischemic CVA.

KEYWORDS :

INTRODUCTION

A stroke is a medical condition in which poor blood flow to the brain results in cell death.[1] There are two main types of stroke: ischemic, due to lack of blood flow, and hemorrhagic, due to bleeding.[2] The main risk factor for stroke is high blood pressure.[3] Other risk factors include tobacco smoking, obesity, high blood cholesterol, diabetes mellitus, a previous TIA, and atrial fibrillation.[4,5] An ischemic stroke is typically caused by blockage of a blood vessel, though there are also less common causes.[6,7,8] A hemorrhagic stroke is caused by either bleeding directly into the brain or into the space between the brain's membranes.[9,10] Bleeding may occur due to a ruptured brain aneurysm.[11] Diagnosis is typically based on a physical exam and supported by medical imaging such as a CT scan or MRI scan.[12] A CT scan can rule out bleeding, but may not necessarily rule out ischemia, which early on typically does not show up on a CT scan.[13] Other tests such as an electrocardiogram (ECG) and blood tests are done to determine risk factors and rule out other possible causes.[14] Low blood sugar may cause similar symptoms.[15]

Prevention includes decreasing risk factors, as well as possibly aspirin, statins, surgery to open up the arteries to the brain in those with problematic narrowing, and warfarin in those with atrial fibrillation.[16] A stroke or TIA often requires emergency care.[17] An ischemic stroke, if detected within three to four and half hours, may be treatable with a medication that can break down the clot.[18] Aspirin should be used.[19] Some hemorrhagic strokes benefit from surgery.[20] Treatment to try to recover lost function is called stroke rehabilitation and ideally takes place in a stroke unit; however, these are not available in much of the world.[21]

Considering those facts in mind, the present proposed study was planned with the following objective- to compare the Lipid Profile patterns between acute ischemic and acute hemorrhagic stroke patients.

MATERIALS AND METHODS
Study Population:
Study was conducted among all the stroke patients admitted in General Medicine department of R.G.KAR.MEDICAL COLLEGE AND HOSPITAL and those fulfilling the inclusion and exclusion criteria from from July 2018 to June 2019. 50 patients with acute haemorrhegic stroke and 50 patients with acute ischemic stroke.

Inclusion Criteria:
1. All patients those will be voluntarily participated in the present study.
2. Age >18 years
3. Both male and female patients are included
4. No prior history of stroke.
5. Duration of illness >24 hours

Exclusion Criteria:
Patients who are already on antilipidemic drug and antihypertensive drug.

Statistical Analysis:
For statistical analysis data were entered into a Microsoft excel spreadsheet and then analyzed by SPSS 24.0. andGraphPad Prism version 5. Data had been summarized as mean and standard deviation for numerical variables and count and percentages for categorical variables. Two-sample t-tests for a difference in mean involved independent samples or unpaired samples. Unpaired proportions were compared by Chi-square test or Fischer's exact test, as appropriate. p-value ≤ 0.05 was considered for statistically significant.

RESULT AND ANALYSIS
We found that in group acute haemorrhegic stroke, the mean of age (mean±s.d.) of patients was 54.6400 ± 7.8240 years with range 33.0000 - 64.0000 years and the median was 56.0000 years. In group acute ischemic stroke, the mean of age (mean±s.d.) of patients was 55.5600 ± 7.0281 years with range 37.0000 - 64.0000 years and the median was 57.0000 years. Association of age in two groups was not statistically significant (p=0.5376).

Our study showed that in group acute haemorrhegic stroke, 18(36.0%) patients had female and 32(64.0%) patients had

male. In group acute ischemic stroke, 22(44.0%) patients had female and 28(56.0%) patients had male. Association of sex in two groups was not statistically significant (p=0.4142) and in group acute haemorrhagic stroke, 42(84.0%) patients had rural locality and 8(16.0%) patients had urban locality. In group acute ischemic stroke, 8(16.0%) patients had rural locality and 8(16.0%) patients had urban locality. Association of locality in two groups was not statistically significant (p=1.000).

It was found that association of SES in two groups was not statistically significant (p=0.9052) and in group acute haemorrhegic stroke, 1(2.0%) patients had convulsion clinical features, 4(8.0%) patients had others clinical features, 10(20.0%) patients had unconscious clinical features and 35(70.0%) patients had weakness clinical features. In group acute ischemic stroke, 1(2.0%) patients had convulsion clinical features, 3(6.0%) patients had others clinical features, 8(16.0) patients had unconscious clinical features and 38(76.0%) patients had weakness clinical features. Association of clinical features in two groups was not statistically significant (p=0.9214).

Our study showed that in group acute haemorrhagic stroke, 29(58.0%) patients had DM. In group acute ischemic stroke, 35(70.0%) patients had DM. Association of DM in two groups was not statistically significant (p=0.2113) and in group acute haemorrhagic stroke, 42(84.0%) patients had HTN. In group acute ischemic stroke, 33(66.0%) patients had HTN. Association of HTN in two groups was statistically significant (p=0.0376). In group acute haemorrhagic stroke, 18(36.0%) patients had past history of stroke. In group acute ischemic stroke, 12(24.0%) patients had past history of stroke. Association of past history of stroke in two groups was not statistically significant (p=0.1904).

We found that association of BMI in two groups was not statistically significant (p=0.1646) and in group acute haemorrhagic stroke, the mean of SBP (mean±s.d.) of patients was 159.4800 ± 21.2653mmHg with range 102.0000 - 198.0000 mmHg and the median was 161.0000 mmHg. In group acute ischemic stroke, the mean of SBP (mean±s.d.) of patients was 140.4000 ± 16.3782 mmHg with range 102.0000 - 164.0000 mmHg and the median was 144.0000 mmHg. Association of SBP in two groups was statistically significant (p<0.0001).

It was found that in group acute haemorrhagic stroke, the mean of DBP (mean±s.d.) of patients was 97.4800 ± 10.0025 mmHg with range 70.0000 - 110.0000 mmHg and the median was 100.0000 mmHg. In group acute ischemic stroke, the mean of DBP (mean±s.d.) of patients was 89.6400 ± 10.1152 mmHg with range 70.0000 - 104.0000 mmHg and the median was 91.0000 mmHg. Association of DBP in two groups was statistically significant (p=0.0002) and in group acute haemorrhagic stroke, the mean of HB% (mean±s.d.) of patients was 11.9620 ± .9087 g/dl with range 10.2000 - 13.6000 g/dl and the median was 11.8000 g/dl. Association of HB% in two groups was not statistically significant (p=0.1718).

Our study showed association of urea in two groups was not statistically significant (p=0.9525) and association of creatinine in two groups was not statistically significant (p=0.5571).

We found that in group acute haemorrhagic stroke, the mean of FBS (mean±s.d.) of patients was 131.0400 ± 25.3763 mg/dl with range 98.0000 - 180.0000 mg/dl and the median was 139.5000 mg/dl. In group acute ischemic stroke, the mean of FBS (mean±s.d.) of patients was 135.5800 ± 25.3555 mg/dl with range 92.0000 - 180.0000 mg/dl and the

median was 140.0000 mg/dl. Association of FBS in two groups was not statistically significant (p=0.3730) and in group acute haemorrhagic stroke, the mean of PPBS (mean±s.d.) of patients was 215.7600 ± 63.6799 mg/dl with range 110.0000 - 304.0000 mg/dl and the median was 245.0000 mg/dl. In group acute ischemic stroke, the mean of PPBS (mean±s.d.) of patients was 223.6800 ± 66.7360 mg/dl with range 110.0000 - 304.0000 mg/dl and the median was 248.0000 mg/dl. Association of PPBS in two groups was not statistically significant (p=0.5452).

It was found that in group acute haemorrhagic stroke, the mean of TCH (mean±s.d.) of patients was 182.3200 ± 18.7404 mg/dl with range 156.0000 - 223.0000 mg/dl and the median was 180.5000 mg/dl. In group acute ischemic stroke, the mean of TCH (mean±s.d.) of patients was 244.0800 ± 53.7598 mg/dl with range 156.0000 - 310.0000 mg/dl and the median was 264.0000 mg/dl. Association of TCH in two groups was statistically significant (p<0.0001) and in group acute haemorrhagic stroke, the mean of TG (mean±s.d.) of patients was 256.1800 ± 27.8456 mg/dl with range 165.0000 - 294.0000 mg/dl and the median was 265.0000 mg/dl. In group acute ischemic stroke, the mean of TG (mean±s.d.) of patients was 268.5800 ± 35.5339 mg/dl with range 160.0000 - 315.0000 mg/dl and the median was 280.0000 mg/dl. Association of TG in two groups was statistically significant (p=0.0550).

Our study showed that in group acute haemorrhagic stroke, the mean of HDL (mean±s.d.) of patients was 41.8600 ± 3.4227 mg/dl with range 34.0000 - 48.0000 mg/dl and the median was 41.0000 mg/dl. In group acute ischemic stroke, the mean of HDL (mean±s.d.) of patients was 37.1000 ± 3.7157 mg/dl with range 31.0000 - 43.0000 mg/dl and the median was 37.5000 mg/dl. Association of HDL in two groups was statistically significant (p<0.0001) and in group acute haemorrhagic stroke, the mean of LDL (mean±s.d.) of patients was 89.2240 ± 18.8438 mg/dl with range 56.6000 - 137.0000 mg/dl and the median was 85.0000 mg/dl. In group acute ischemic stroke, the mean of LDL (mean±s.d.) of patients was 153.2640 ± 50.7364 mg/dl with range 68.8000 - 223.0000 mg/dl and the median was 167.8000 mg/dl. Association of LDL in two groups was statistically significant (p<0.0001).

We found that in group acute haemorrhagic stroke, the mean of VLDL (mean±s.d.) of patients was 51.2360 ± 5.5691 mg/dl with range 33.0000 - 58.8000 mg/dl and the median was 53.0000 mg/dl. In group acute ischemic stroke, the mean of VLDL (mean±s.d.) of patients was 53.7160 ± 7.1068 mg/dl with range 32.0000 - 63.0000 mg/dl and the median was 56.0000 mg/dl. Association of VLDL in two groups was statistically significant (p=0.0550) and in group acute haemorrhagic stroke, all patients had haemorrhagic stroke CT scan. In group acute ischemic stroke, all patients had ischemic stroke CT scan. Association of CT scan. in two groups was statistically significant (p<0.0001).

DISCUSSION
Present study was conducted in the department of General Medicine in R.G.Kar Medical College & Hospital, West Bengal. 100 patients were selected using above defined criteria, 50 patients had in acute ischemic stroke and 50 patients had in acute haemorrhegic stroke. Present study was conducted from July 2018 to June 2019.

We found that association of age in two groups was not statistically significant (p=0.5376). We found that association of sex in two groups was not statistically significant (p=0.4142).

Manorenj S et al [22] found that mean age was 53±14.4. ICH

was frequent in older age (57.6%) with male gender predominance (73%). Most frequent location of bleed was in thalamus (30.7%). Low density lipoprotein (LDL), triglyceride (TG) and very low density lipoprotein (VLDL) cholesterol were significantly low in ICH patients compared to controls. There was no significant difference in the high density lipoprotein (HDL) levels in both groups. Mean total cholesterol was significantly low in a subset of study group that included male gender, younger onset stroke (<50 years) and with prior history of hypertension. Subgroup analysis in ICH group showed significantly low mean total cholesterol, LDL and TG cholesterol in statin group compared to non-statin group.

Association of SES in two groups was not statistically significant (p=0.9052).

Association of clinical features in two groups was not statistically significant (p=0.9214).

Togha M et al [23] found that except for TG values, there was no significant difference among the ischemic and hemorrhagic lipid profile. Age, cholesterol, and LDL influenced the risk of developing an ischemic stroke; TG was not reported as a risk factor or a protective one. While the comparison of data retrieved from patients suffering from hemorrhagic strokes with the controls, revealed LDL as the risk factor contributing to the development of ICH whereas TG was reported as a protective factor. It could be concluded that LDL level can be considered as a risk factor for both ischemic and hemorrhagic cerebral events. We found that Association of DM in two groups was not statistically significant (p=0.2113).

We found that association of SBP in two groups was statistically significant (p<0.0001).

In group acute haemorrhagic stroke, the mean of DBP (mean±s.d.) of patients was 97.4800 ± 10.0025 mmHg with range 70.0000 - 110.0000 mmHg and the median was 100.0000 mmHg. In group acute ischemic stroke, the mean of DBP (mean±s.d.) of patients was 89.6400 ± 10.1152 mmHg with range 70.0000 - 104.0000 mmHg and the median was 91.0000 mmHg. Association of DBP in two groups was statistically significant (p=0.0002).

Mahmood A et al [24] found that total serum cholesterol, triglycerides, LDLcholesterol, VLDL-cholesterol and HDL-cholesterol was determined, using enzymatic colorimetric method. Statistical analysis was done by comparison of lipid profile in two subgroups, using proportion test for any significant difference. The mean age at presentation of patients with stroke was 64.2±12 years with a male to female ratio of 3.6:1. In 100 ischaemic stroke patients, raised serum total cholesterol was seen in 42, triglyceride in 04, LDL-cholesterol in 05 and VLDL-cholesterol in 07 patients. Serum HDL-cholesterol was below the normal reference in 31 cases. On the other hand, serum total cholesterol and triglycerides was raised in 05 patients each, LDL-cholesterol in 09 and VLDL-cholesterol in 03 patients of haemorrhagic stroke. Serum HDL-cholesterol was below normal in 04 patients of haemorrhagic stroke. On comparison, there were significantly greater number of patients with raised serum cholesterol and low HDL-cholesterol in ischaemic stroke than haemorrhagic stroke (p < 0.05). No statistical significance was found on comparing serum values of ischaemic and haemorrhagic stroke for triglycerides, LDL-cholesterol and VLDL-cholesterol. Ischaemic stroke patients had high serum total cholesterol and lower HDL-cholesterol levels as compared to haemorrhagic stroke. High risk patients of stroke may be screened using serum lipid profile and further studies are suggested to evaluate the effect of lipid lowering therapy in terms of morbidity and mortality in ischaemic stroke patients.

We found that association of TCH in two groups was statistically significant (p<0.0001).

In group acute haemorrhagic stroke, the mean of TG (mean±s.d.) of patients was 256.1800 ± 27.8456 mg/dl with range 165.0000 - 294.0000 mg/dl and the median was 265.0000 mg/dl. In group acute ischemic stroke, the mean of TG (mean±s.d.) of patients was 268.5800 ± 35.5339 mg/dl with range 160.0000 - 315.0000 mg/dl and the median was 280.0000 mg/dl. Association of TG in two groups was statistically significant (p=0.0550). We found that association of HDL in two groups was statistically significant (p<0.0001).

In group acute haemorrhagic stroke, the mean of LDL (mean±s.d.) of patients was 89.2240 ± 18.8438 mg/dl with range 56.6000 - 137.0000 mg/dl and the median was 85.0000 mg/dl. In group acute ischemic stroke, the mean of LDL (mean±s.d.) of patients was 153.2640 ± 50.7364 mg/dl with range 68.8000 - 223.0000 mg/dl and the median was 167.8000 mg/dl. Association of LDL in two groups was statistically significant (p<0.0001). Association of VLDL in two groups was statistically significant (p=0.0550).

Dan S et al [25] found that dyslipidemia is associated with both types of stroke . However hyper cholesterolemia is significantly more associated with ischemic CVA. Low HDL – cholesterol is also significantly more prevalent in ischemic CVA group in our study. Findings suggested that ischemic stroke patients had higher serum total cholesterol and lower HDL- cholesterol levels in comparison to haemorrhagic stroke.

We found that in group acute haemorrhagic stroke, all patients had haemorrhagic stroke CT scan. In group acute ischemic stroke, all patients had ischemic stroke CT scan. Association of CT scan. in two groups was statistically significant (p<0.0001).

CONCLUSION

High blood lipid levels are associated with an increased risk of Ischemic stroke. DM, total cholesterol, Triglyceride, LDL, VLDL and HDL influenced the risk of developing an ischemic stroke.Dyslipidemia is associated with both types of stroke. However hyper cholesterolemia is significantly more associated with ischemic CVA. Low HDL – cholesterol is also significantly more prevalent in ischemic CVA group in our study. Findings suggested that ischemic stroke patients had higher serum total cholesterol and lower HDL-cholesterol levels in comparison to hemorrhagic stroke. Systolic Blood Pressure and Diastolic Blood Pressure were significantly associated with haemorrhagic stroke.

Table: Distribution Of Mean Age, BMI, SBP, DBP, HB%, Urea, Creatinine, FBS, PPBS, TCH, TG, HDL, LDL and VLDL In Two Groups

		Number	Mean	SD	Minimum	Maximum	Median	p-value
Age (Yrs)	Acute Haemorrhegic Stroke	50	54.6400	7.8240	33.0000	64.0000	56.0000	0.5376
	Acute Ischemic Stroke	50	55.5600	7.0281	37.0000	64.0000	57.0000	
BMI (Kg/m2)	Acute Haemorrhagic Stroke	50	22.2340	2.6278	19.2000	28.3000	21.4000	0.1646
	Acute Ischemic Stroke	50	21.5440	2.2879	19.2000	28.3000	21.4000	
SBP	Acute Haemorrhagic Stroke	50	159.4800	21.2653	102.0000	198.0000	161.0000	<0.0001

		N	Mean	SD	Min	Max	Median	p
	Acute Ischemic Stroke	50	140.4000	16.3782	102.0000	164.0000	144.0000	
DBP	Acute Haemorrhagic Stroke	50	97.4800	10.0025	70.0000	110.0000	100.0000	0.0002
	Acute Ischemic Stroke	50	89.6400	10.1152	70.0000	104.0000	91.0000	
HB%	Acute Haemorrhagic Stroke	50	11.9620	.9087	10.2000	13.6000	11.8000	0.1718
	Acute Ischemic Stroke	50	12.2380	1.0881	10.2000	14.2000	12.4000	
Urea	Acute Haemorrhagic Stroke	50	35.5880	13.3602	25.0000	87.0000	31.2000	0.9525
	Acute Ischemic Stroke	50	35.7460	13.1124	26.3000	87.0000	31.2000	
Creatinine	Acute Haemorrhagic Stroke	50	1.7580	.7938	0.7800	5.0000	1.6350	0.5571
	Acute Ischemic Stroke	50	1.6636	.8085	0.8500	5.0000	1.5000	
FBS	Acute Haemorrhagic Stroke	50	131.0400	25.3763	98.0000	180.0000	139.5000	0.3730
	Acute Ischemic Stroke	50	135.5800	25.3555	92.0000	180.0000	140.0000	
PPBS	Acute Haemorrhagic Stroke	50	215.7600	63.6799	110.0000	304.0000	245.0000	0.5452
	Acute Ischemic Stroke	50	223.6800	66.7360	110.0000	304.0000	248.0000	
TCH	Acute Haemorrhagic Stroke	50	182.3200	18.7404	156.0000	223.0000	180.5000	<0.0001
	Acute Ischemic Stroke	50	244.0800	53.7598	156.0000	310.0000	264.0000	
TG	Acute Haemorrhagic Stroke	50	256.1800	27.8456	165.0000	294.0000	265.0000	0.0550
	Acute Ischemic Stroke	50	268.5800	35.5339	160.0000	315.0000	280.0000	
HDL	Acute Haemorrhagic Stroke	50	41.8600	3.4227	34.0000	48.0000	41.0000	<0.0001
	Acute Ischemic Stroke	50	37.1000	3.7157	31.0000	43.0000	37.5000	
LDL	Acute Haemorrhagic Stroke	50	89.2240	18.8438	56.6000	137.0000	85.0000	<0.0001
	Acute Ischemic Stroke	50	153.2640	50.7364	68.8000	223.0000	167.8000	
VLDL	Acute Haemorrhagic Stroke	50	51.2360	5.5691	33.0000	58.8000	53.0000	0.0550
	Acute Ischemic Stroke	50	53.7160	7.1068	32.0000	63.0000	56.0000	

Dysglycemia was asoociated with ischemic stroke.

REFERENCE

1. Donnan GA, Fisher M, Macleod M, Davis SM (May 2008). "Stroke". Lancet. 371 (9624): 1612–23. doi:10.1016/S0140-6736(08)60694-7. PMID 18468545.(subscription required)
2. PhD, Gary Martin (2009). Palliative Care Nursing: Quality Care to the End of Life, Third Edition. Springer Publishing Company. p. 290. ISBN 9780826157928. Archived from the original on 2017-08-03.
3. World Health Organisation (1978). Cerebrovascular Disorders (Offset Publications). Geneva: World Health Organization. ISBN 92-4-170043-2. OCLC 4757533.
4. Kidwell CS, Warach S (December 2003). "Acute ischemic cerebrovascular syndrome: diagnostic criteria". Stroke. 34 (12): 2995–8. doi:10.1161/01.STR.0000098902.69855.A9. PMID 14605325.
5. Shuaib A, Hachinski VC (September 1991). "Mechanisms and management of stroke in the elderly". CMAJ. 145 (5): 433–43. PMC 1335826. PMID 1878825.
6. Stam J (April 2005). "Thrombosis of the cerebral veins and sinuses". The New England Journal of Medicine. 352 (17): 1791–8. doi:10.1056/NEJMra042354. PMID 15858188.
7. Guercini F, Acciarresi M, Agnelli G, Paciaroni M (April 2008). "Cryptogenic stroke: time to determine aetiology". Journal of Thrombosis and Haemostasis. 6 (4): 549–54. doi:10.1111/j.1538-7836.2008.02903.x. PMID 18208534.
8. Bamford J, Sandercock P, Dennis M, Burn J, Warlow C (June 1991). "Classification and natural history of clinically identifiable subtypes of cerebral infarction". Lancet. 337 (8756): 1521–6. doi:10.1016/0140-6736(91)93206-O. PMID 1675378. Later publications distinguish between "syndrome" and "infarct", based on evidence from imaging. "Syndrome" may be replaced by "hemorrhage" if imaging demonstrates a bleed. See Internet Stroke Center. "Oxford Stroke Scale". Archived from the original on 2008-10-25. Retrieved 2008-11-14.
9. Bamford JM (2000). "The role of the clinical examination in the subclassification of stroke". Cerebrovascular Diseases. 10 Suppl 4: 2–4. doi:10.1159/000047582. PMID 11070389.
10. Adams HP, Bendixen BH, Kappelle LJ, Biller J, Love BB, Gordon DL, Marsh EE (January 1993). "Classification of subtype of acute ischemic stroke. Definitions for use in a multicenter clinical trial. TOAST. Trial of Org 10172 in Acute Stroke Treatment". Stroke. 24 (1): 35–41. doi:10.1161/01.STR.24.1.35. PMID 7678184.[permanent dead link]
11. Anonymous (6 December 2013). "Types of Stroke". www.cdc.gov. Centers of Disease Control and Prevention. Archived from the original on 27 June 2016. Retrieved 30 June 2016.
12. Salman, R. A.-S.; Labovitz, D. L; Stapf, C. (24 July 2009). "Spontaneous intracerebral haemorrhage". BMJ. 339 (jul24 1): b2586–b2586. doi:10.1136/bmj.b2586. PMID 19633038.
13. Goldstein LB, Simel DL (May 2005). "Is this patient having a stroke?". JAMA. 293 (19): 2391–402. doi:10.1001/jama.293.19.2391. PMID 15900010.
14. Harbison J, Massey A, Barnett L, Hodge D, Ford GA (June 1999). "Rapid ambulance protocol for acute stroke". Lancet. 353 (9168): 1935. doi:10.1016/S0140-6736(99)00966-6. PMID 10371574.
15. Kidwell CS, Saver JL, Schubert GB, Eckstein M, Starkman S (1998). "Design and retrospective analysis of the Los Angeles Prehospital Stroke Screen (LAPSS)". Prehospital Emergency Care. 2 (4): 267–73. doi:10.1080/10903129808958878. PMID 9799012.
16. Kothari RU, Pancioli A, Liu T, Brott T, Broderick J (April 1999). "Cincinnati Prehospital Stroke Scale: reproducibility and validity". Annals of Emergency Medicine. 33 (4): 373–8. doi:10.1016/S0196-0644(99)70299-4. PMID 10092713.
17. Nor AM, Davis J, Sen B, Shipsey D, Louw SJ, Dyker AG, Davis M, Ford GA (November 2005). "The Recognition of Stroke in the Emergency Room (ROSIER) scale: development and validation of a stroke recognition instrument". Lancet Neurology. 4 (11): 727–34. doi:10.1016/S1474-4422(05)70201-5. PMID 16239179.
18. Fisher CM (1968-12-18). "The arterial lesions underlying lacunes". Acta Neuropathologica. 12 (1): 1–15. doi:10.1007/BF00685305. PMID 5708546.
19. National Institute of Neurological Disorders and Stroke (NINDS) (1999). "Stroke: Hope Through Research". National Institutes of Health. Archived from the original on 2015-10-04.
20. Shah, A. S. V.; Lee, K. K.; McAllister, D. A.; Hunter, A.; Nair, H.; Whiteley, W.; Langrish, J. P.; Newby, D. E.; Mills, N. L. (24 March 2015). "Short term exposure to air pollution and stroke: systematic review and meta-analysis". BMJ. 350 (mar23 11): h1295–h1295. doi:10.1136/bmj.h1295.
21. Robbins and Cotran Pathologic Basis of Disease, Professional Edition (8th ed.). Philadelphia, Pa: Elsevier. 2009. ISBN 978-1-4377-0792-2. |first1= missing |last1= in Authors list (help)
22. Manorenj S, Siddiqui IA, Inturi S, Barla S. Blood lipid levels, statin therapy and risk of intracerebral hemorrhage versus ischemic vascular events: a prospective case control study from tertiary care center of south India. International Journal of Research in Medical Sciences. 2016 Dec 19;4(11):4857-61.
23. Togha M, Gheini MR, Ahmadi B, Khashaiar P, Razeghi S. Lipid profile in cerebrovascular accidents. Iranian journal of neurology. 2011;10(1-2):1.
24. Mahmood A, Sharif MA, Khan MN, Ali UZ. Comparison of serum lipid profile in ischaemic and haemorrhagic stroke. J Coll Physicians Surg Pak. 2010 May 1;20(5):317-20.
25. Dan S, Kant M, Dey S, Pal PS, Kusvaha GK, Joseph A. Comparative Study of Lipid Abnormality in Ischemic and Haemorrhagic Stroke in Tribal Population of west Bengal.