Preliminary Evaluations Related to the Ranges of Hematological and Biochemical Variables in Hospitalized Patients with Stroke

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ABSTRACT

Background: According to the international reports, brain stroke is the main reason of death and disability. In ischemic stroke, early and precise classification of patients who may profit from conflicting finest therapeutic interference is necessary if enhanced effects in terms of survival are to be talented. Due to uncomplicated, easy performance, and inexpensive method the aim of this preliminary study was to investigate changes related to biochemical and hematological variables in patients with stroke.

Methods: A cross-sectional study located at the neurology ward of the Ayatolah Kashani and Alzahra Hospitals' (conducted to Isfahan Neurosciences Research Center) was carried out on fifty patients (females; $n = 20$ and males; $n = 30$) between April 1, 2012 and September 31, 2012. The data from subjects' records were taken for analyzing variables. The statistical analysis of d-base was performed using (SPSS) for windows.

Results: Analysis of available data showed that with a mean of 182.4 mg/dl, blood sugar (BS) ranged from 75 to 300 mg/dl ($n = 15/50$). The changes in hemoglobin (Hgb) (mean 4.6 g/dl, $n = 27/50$), platelet (mean 210, 653/mm^3, $n = 26/50$) and lymphocyte (Lymph) (mean 37, $n = 26/50$) seems to be significant. The mean age of females was 76 years (ranged 46-93 years). The mean age of males was 70 years (ranged 31-90 years). Information related to previous drug history was available only in 24 patients. In 5 out of 22 cases ischemic heart disease (IHD) were positive. In 8 out of 29 cases, diabetes mellitus was positive. In 5 out of 28 cases, hypertension (HTN) was positive. In the four patients both IHD and HTN were positive.

Conclusions: Any considerable alter in patients' biochemical and hematological figures (BS, Hgb, Plt and Lymph) may necessitate further attention related to inter- and intra-individual variability in clinical supervision and drug's assortment. Therefore, success in treatment could be achieved by the close management of clinical, biochemical, hematological, and pharmacological manifestation. To reduce disability, mortality, and morbidity in Iranian stroke population further clinical studies are needed to correlate drugs and laboratory markers to associated clinical events in order.

Keywords: Biochemical, hematological, stroke

Brief Communication

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INTRODUCTION

Stroke, dementia, and neuropsychiatric disarrays are the major turmoil underlying disability. In the derivation of white matter modification, injuries to the tiny incisive arterioles of the brain, arteriolosclerosis (provoked by timing, hypertension, high resistin), diabetes, and hereditary susceptibility, plays an important role. The pathological vascular barrier procedure pilots to lumen restriction, spoiled facility to adapt lumen width according to metabolic requirements and viable ischemic-hypoxic tissue injuries in the vulnerable vascular architectural inoperable areas of the stretched stabbing arteries. The arteriolosclerotic blood vessels are associated with inflammation and altering of the extracellular surroundings. Enzymes related to this evolution have also been reputable to be alarmed in demyelination and blood brain barrier gap but also in the revamp route of angiogenesis and neurogenesis. Biochemical amends dazzling these dealings that might be early pointers of tiny vessel ailment and therefore amplify the facts about the syndrome feature means.[1-7] The methods of decision for identification of stroke in Isfahan, Iran, are based on neuroimaging such as computed tomography scanning, magnetic resonance imaging and hematological–biochemical variables. A biochemical marker that is straightforward, low-priced, carried out regularly and recurred frequently in the hospital clinical laboratory is linked to the ischemic cascade that could have the potential to predict outcomes before, during, and after stroke. Such markers are associated with signs of early neurological deterioration, final infarct volume, and many other outcomes. According to previous reports, advancing age, large-vessel stroke, atrial fibrillation, tobacco smoking and previous stroke/transient ischemic attack, albumin, creatinine, elevated total white cell count, urea and the hemostatic factors von Willebrand factor and thromboglobulin were predict mortality in patients with ischemic stroke.[8-15] In order to predict ischemic stroke based on clinical and laboratory trials, the aim of this preliminarily study was to investigate the ranges of hematological and biochemical in Iranian ischemic stroke population.

METHODS

A cross-sectional study of fifty patients with stroke (females; n = 20 and males; n = 30) located at the neurology ward (conducted to Isfahan Neurosciences Research Centre) was carried out between April 1, 2012 and September 31, 2012. There was no induction in treatment procedure. The mean age of all patients was 73 years (ranged 31-93 years). Patients' conditions were determined based on the medical records. Wherever it was noted, the presence of hypertension, hypercholesterolemia, diabetes mellitus (DM), history of TIA/stroke, congestive heart failure, coronary artery disease, preadmission use of antihypertensive or antithrombotic agents and drugs history were recorded in d-base. Clinical, biochemical, and hematological data were recorded initially in d-base and processed using Microsoft Excel and (SPSS) (version 18.0) for windows.

RESULTS

The mean age of females was 76 years (ranged 46-93 years). The mean age of males was 70 years (ranged 31-90 years). Analysis of individual drug charts showed that drugs assortment (generic and brand-name) were included; ranitidine (n = 40), atorvastatin (n = 40), aspirin (n = 22), warfarin (n = 14), captopril (n = 13), nitrocantine (n = 12), metoral (n = 9), losartan (n = 9), enoxaparin (n = 8), ceftriaxone (n = 7), furosemide (n = 6), amlodipine (n = 6), digoxin (n = 4), heparin (n = 3), spironolactone (n = 2), cerebrolysin (n = 3), ceftazidime (n = 2), clindamycin (n = 3), etc.

According to the medical notes: (1) Information related to previous drug history was only available in 24/50, (2) in 5/22 ischemic heart disease (IHD) was positive, (3) in 8/29, DM was positive, (4) in 5/28 hypertension (HTN) was positive, and (5) In four patients both IHD and HTN were positive.

As shown in Table 1, preliminary analysis of available biochemical and hematological variables showed that: White blood cell (WBC) count with a mean of 8381 mm^3 (ranged 4500-12,400 mm^3, n = 27), red blood cell (RBC) count with a mean of 4.6 mil/mm^3 (ranged 3.26-6.28 mil/mm^3, n = 27), hemoglobin with a mean of 4.6 $g/dl^{\downarrow}$ (ranged 8.7-16.8 g/dl, n = 27), hematocrit (Ht) with a mean of 38.7% (ranged 30.3-50.1%, n = 27), platelet (Plt) with a mean of 210,653/mm^3 (ranged 63,000-407,000/mm^3, n = 26), lymphocyte (Lymph) with a mean of 37.1% (ranged 5.9-77.8%, n = 26), blood sugar (BS) with a mean of 182.4 $mg/dl^{\uparrow}$ (ranged 75-300 mg/dl, n = 15)

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Table 1: Clinical biochemistry and hematology variables: All patients (*n*=50)

Serum biochemistry/ hematology parameters	Normal range	All patients' mean (minimum-maximum)
WBC	4400-11,000/mm^3	8381 (4500-12,400) (*n*=27)
RBC	M: 4.5-5.9 mil/mm^3 (F: 4.1-5.1)	4.6 (3.26-6.28) (*n*=27)
Hgb	M: 14-17.5 g/dl (F: 12.3-15.3)	4.6 (8.7-16.8) (*n*=27)
Ht	M: 41.5-50.5% (F: 35.9-44.9)	38.3 (30.3-50.1) (*n*=27)
MCV	M: 80-96 fl (F: 79-96)	85.7 (61.1-102.7) (*n*=26)
MCH	M: 27.5-33.2 pg (F: 27-33)	29.7 (17.3-79.6) (*n*=27)
MCHC	M: 33-35.5 g/dl (F: 33-35.5)	32.7 (28.4-34.9) (*n*=27)
Plt	150,000-450,000/mm^3	210,653 (63,000-407,000) (*n*=26)
Lymph	20-40%	37.1 (5.9-77.8) (*n*=26)
Na	135-145 mEq/l	137.8 (120-150) (*n*=20)
K	3.5-5 mEq/l	4.2 (2.3-5.4) (*n*=19)
Creat.	0.4-1.2 mg/dl	1.1 (0.7-1.7) (*n*=21)
BUN	8-24 mg/dl	20.9 (10-35) (*n*=23)
Ca	8.2-10.6 mg/dl	9.5 (8.2-10.5) (*n*=6)
P	2.5-4.5 mg/dl	3.8 (2.7-5.1) (*n*=5))
BS	70-110 mg/dl	182.4 (75-300) (*n*=15)

WBC= White blood cell, RBC= Red blood cell, Hgb= Hemoglobin, Ht= Hematocrit, MCV= Mean corpuscular volume, MCH= Mean corpuscular hemoglobin, Plt= Platelets, Lymph= Lymphocyte, Na= Sodium, K= Potassium, Creat.=Creatinine, BUN= Blood urea nitrogen, Ca= Calcium, P= Phosphorous, BS= Blood sugar

and so on. Table 2 shows the most significant determinant in patients with defined code number. The corresponding variables were Lymph, WBC counts, hemoglobin (Hgb), Ht, RBC, Plt, and BS. In seven patients, Hgb and Ht was less than normal value in both genders. As shown in Figure 1, in nine patients Lymph with a mean value of 13.7% was lower than 20% and in two patients with a mean value of 63.9% was higher than 40% respectively. In three patients, WBC was significantly higher than normal value (n > 11,000/mm^3).

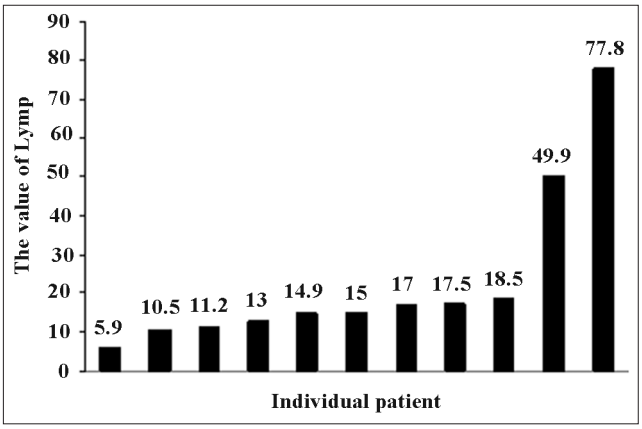

Figure 1: Individual value in patients with elevated lymphocyte (n = 9↓ and n = 2↑)

DISCUSSION

In Iranian stroke population, the major interpretative consideration to select a suitable pattern of pharmacotherapy immediately after acute ischemic stroke could be based on clinical and laboratory manifestation. From the clinical accounts offered in this article, numerous active variables especially laboratory indicators emerge to be exaggerated in acute ischemic stroke. Analysis of biochemical and hematological values showed an increased WBC count,[16] increased BS[17-20] and a decreased in Hgb, Ht., RBC count,[21] changed Lymph (involved an increased; n = 2 and a decreased; n = 9, in both genders).[22-24] These

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Table 2: Drug details in patients with abnormal hematology and biochemical parameters.

Patient's code and age	Types of drugs used in each prescription	Abnormal parameter and possible clinical outcome	Changed values
33; 80	N/S, Ranitidin, Insulin, ASA (also low Lymph 13)	WBC counts/mm^3	11,900↑
16; 85	N/S, Ranitidin, Cefipim, Celexan, Nitrocantine, Citicholin (also low Lymph 10.5, ↑BS)		12,800↑
13; 31	N/S, Ranitidin, Pentoprazol, Hydrocortison, Cefipim, Morphin (P.R.N.), Atrovastatin, Salbutamol, Supp. Acetaminophen, Captopril, Celexan, Warfarin, low RBC: 3.53, low Hgb: 10.7, low platelet: 78,000, ↑BS		14,200↑
26; 62	N/S, Ranitidin, Celexan, Atrovastatin, Atenolol, ASA; low platelet 63,000, ↑BS		14,000↑
34; 84	N/S, Ranitidin, Insulin, Heparin, Atrovastatin, Captopril, Warfarin Prazocin	RBC, Hgb, Ht	3.26↓ 29.6↓ 30.5↓
11; 78	N/S, Ranitidin, Halopridol, Celexan, Atrovastatin, Losartan, ASA, Warfarin, Verapamil		3.47↓ 12.4↓ 40.3↓
35; 85	N/S, Ranitidin, Atrovastatin, Osvix, Nitrocantine, Amlodipine, Atenolo, ↑BS		3.47↓ 12.7↓ 40↓
27; 61	N/S, Ranitidin, Atrovastatin, Osvix, Citicholine		3.71↓ 10.6↓ 34.8↓
18; 81	N/S, Ranitidin, Domperidone, Ceftazidim, Clidamicin, Atrovastatin, Osvix, Celexan	Elevated Lymph	3.98 12.5 37.7
19; 88	N/S, Atrovastatin, Losaratan, Omeparazol		5.9
14; 74	N/S, Ranitidin, Domperidone, Ceftriaxon, Atrovastatin, Nitrocantine, Metoral, Celexan, Warfarin, Lacotolose, ↑BS		14.9↓
12; 53	N/S, Ranitidin, Atrovastatin, Nitrocantine, Celexan, Warfarin		15↓
36; 75	N/S, Ranitidin, Atrovastatin, Phenazopridin Captopril, ASA		17↓
22; 60	N/S, Ranitidin, Cerberolysin, Atrovastatin, Hyoscin, Captopril, Metoral, ↑BS		17.5↓
31; 55	N/S, Ranitidin, Celexan, Atrovastatin, Gabapentin, ASA		18.5↓
20; 53	N/S, Atrovastatin, ASA, Sodium Valproate, Citalopram, Metoral		49.9↑
15; 77	N/S, Celexan, Atrovastatin, Nitrocantine, Captopril, ASA		↑77.8↑
28; 93	N/S, Ranitidin, Celexan, Atrovastatin, Losartane, Warfarin	Blood sugar	172↑
17; 75	Cephalexin, Celexan, Atrovastatin, Captopril, Amlodipine, ASA		176↑
23; 82	Atrovastatin, Osvix		192↑
25; 56	N/S, Ranitidin, Atrovastatin, Osvix, ASA		200↑

WBC=White blood cell, RBC=Red blood cell, Hgb=Hemoglobin, Ht=Hematocrit, Lymph=Lymphocyte, BS=Blood sugar

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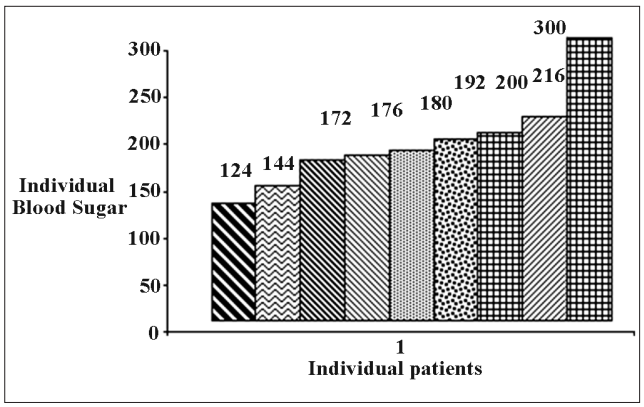

Figure 2: Individual value in patients with high blood sugar

findings is in agreement with previous publications that reported an alteration in hematological and biochemical parameters, Erythrocyte sedimentation rate test (ESR), WBC count, polymorph, Lymph, and total protein levels in discharged and expired patients.[16-26] Lymphocytopenia or lymphopenia in patients considered here (n = 9), could be due to Lymph destroying, inability of patients' body to make Lymph, or it might get trapped in the spleen or lymph nodes. Judgment related to this event is in agreement with a recent publication which confirms that in the pathogenesis of stroke-induced sympathetic hyperactivation and immunodepression a specific role of insular lesion could be involved.[27-29] A high WBC count or leukocytosis in patients studied here (n = 2), could be pinpointing of a vast immune system complexity, a disease bone marrow that activates high blood cell generation, a response to some drugs used in this studied population or an infection. Previous publication reported that elevated leukocyte count has been associated with cardiovascular and cerebrovascular disease in several epidemiological studies.[16] Severe hyperglycemia has been shown to be associated negatively with an effect in stroke patients. An increase in BS here could be connected with improved cortical toxicity and larger infarct volumes following focal cerebral ischemia. Preliminary blood glucose in some patients in this study may also donate to a discrepancy reaction to thrombolysis. Previous publication reported that infarct volume expansion was greater in individuals with hyperglycemia on admission regardless of collateral circulation status.[17-20] A decreased value of Hgb and Ht in patients (n = 2) could develop anemia, as previous publication.[21,29-32]

CONCLUSIONS

To diminish the scope of brain frustrated by ischemia, pharmacotherapy could be acknowledged by the protected control of medical, biochemical, and hematological emergence. In order to improve quality and quantity of life after ischemic stroke (to reduce disability, mortality, and morbidity) advanced studies related to manipulation of drugs (especially anticoagulant) could be beneficial in Iranian stroke population.

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REFERENCES

1. Wallin A, Ohrfelt A, Bjerke M. Characteristic clinical presentation and CSF biomarker pattern in cerebral small vessel disease. J Neurol Sci 2012;322:192-6.
2. Maiese K. The many facets of cell injury: Angiogenesis to autophagy. Curr Neurovasc Res 2012;9:83-4.
3. Kochanowski J, Grudniak M, Baranowska-Bik A, Wolinska-Witort E, Kalisz M, Baranowska B, *et al*. Resistin levels in women with ischemic stroke. Neuro Endocrinol Lett 2012;33:603-7.
4. Nayak AR, Kashyap RS, Kabra D, Deoras P, Purohit HJ, Taori GM, *et al*. Evaluation of routinely performed hematological and biochemical parameters for the prognosis of acute ischemic stroke patients. Neurol Sci 2011;32:855-60.
5. Osawa H, Doi Y, Makino H, Ninomiya T, Yonemoto K, Kawamura R, *et al*. Diabetes and hypertension markedly increased the risk of ischemic stroke associated with high serum resistin concentration in a general Japanese population: The Hisayama Study. Cardiovasc Diabetol 2009;8:60.
6. Sims NR, Muyderman H. Mitochondria, oxidative metabolism and cell death in stroke. Biochim Biophys Acta 2010;1802:80-91.
7. Baccarani Contri M, Taparelli F, Miselli M, Bacchelli B, Biagini G. Histomorphometric, biochemical and ultrastructural changes in the aorta of salt-loaded stroke-prone spontaneously hypertensive rats fed a Japanese-style diet. Nutr Metab Cardiovasc Dis 2003;13:37-45.
8. Sohrabji F, Selvamani A, Balden R. Revisiting the timing hypothesis: Biomarkers that define the therapeutic window

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of estrogen for stroke. Horm Behav 2013;63:222-30.
9. Carter AM, Catto AJ, Mansfield MW, Bamford JM, Grant PJ. Predictive variables for mortality after acute ischemic stroke. Stroke 2007;38:1873-80.
10. Woo J, Lau E, Kay R, Lam CW, Cheung CK, Swaminathan R, *et al*. A case control study of some hematological and biochemical variables in acute stroke and their prognostic value. Neuroepidemiology 1990;9:315-20.
11. Fowler SB, Mancini B. Predictive value of biochemical markers in stroke. J Neurosci Nurs 2007;39:58-60.
12. Castillo J, Rodríguez I. Biochemical changes and inflammatory response as markers for brain ischaemia: Molecular markers of diagnostic utility and prognosis in human clinical practice. Cerebrovasc Dis 2004;17:7-18.
13. Han JY, Choi DH, Choi SW, Kim BB, Ki YJ, Chung JW, et al. Stroke or coronary artery disease prediction from mean platelet volume in patients with type 2 diabetes mellitus. Platelets; 2012 Aug 7.
14. Chu SG, Becker RC, Berger PB, Bhatt DL, Eikelboom JW, Konkle B, *et al*. Mean platelet volume as a predictor of cardiovascular risk: A systematic review and meta-analysis. J Thromb Haemost 2010;8:148-56.
15. Turfan M, Erdogan E, Ertas G, Duran M, Murat SN, Celik E, *et al*. Usefulness of mean platelet volume for predicting stroke risk in atrial fibrillation patients. Blood Coagul Fibrinolysis 2013;24:55-8.
16. Elkind MS, Cheng J, Boden-Albala B, Paik MC, Sacco RL, Northern Manhattan Stroke Study. Elevated white blood cell count and carotid plaque thickness: The northern Manhattan stroke study. Stroke 2001;32:842-9.
17. Yoon SS, Zheng ZJ. Elevated total white blood cell count with high blood glucose is associated with poor outcome after ischemic stroke. J Stroke Cerebrovasc Dis 2005;14:88-93.
18. Southerland AM, Johnston KC. Considering hyperglycemia and thrombolysis in the Stroke Hyperglycemia Insulin Network Effort (SHINE) trial. Ann N Y Acad Sci 2012;1268:72-8.
19. Shimoyama T, Shibazaki K, Kimura K, Uemura J, Shiromoto T, Watanabe M, *et al*. Admission hyperglycemia causes infarct volume expansion in patients with ICA or MCA occlusion: Association of collateral grade on conventional angiography. Eur J Neurol 2013;20:109-16.
20. Link TW, Woodworth GF, Chaichana KL, Grossman SA, Mayer RS, Brem H, *et al*. Hyperglycemia is independently associated with post-operative function loss in patients with primary eloquent glioblastoma. J Clin Neurosci 2012;19:996-1000.
21. Hao Z, Wu B, Wang D, Lin S, Tao W, Liu M. A cohort study of patients with anemia on admission and fatality after acute ischemic stroke. J Clin Neurosci 2013;20:37-42.
22. Kurabayashi H, Machida I, Handa H, Yoshida Y, Akiba T, Itoh K, *et al*. Effects of physical therapy on cytokines and two color analysis-lymphocyte subsets in patients with cerebrovascular diseases. J Med 1999;30:31-7.
23. Major EO, Amemiya K, Tornatore CS, Houff SA, Berger JR. Pathogenesis and molecular biology of progressive multifocal leukoencephalopathy, the JC virus-induced demyelinating disease of the human brain. Clin Microbiol Rev 1992;5:49-73.
24. Członkowska A, Cyrta B, Korlak J. Immunological observations on patients with acute cerebral vascular disease. J Neurol Sci 1979;43:455-64.
25. Gabe SM, Bjarnason I, Tolou-Ghamari Z, Tredger JM, Johnson PG, Barclay GR, *et al*. The effect of tacrolimus (FK506) on intestinal barrier function and cellular energy production in humans. Gastroenterology 1998;115:67-74.
26. Tolou Ghamari Z. Antiepileptic Drugs (AEDs) Polypharmacy could lead to buried pharmacokinetic interactions due to CYP450. Drug Metab Lett 2012 [Epub ahead of print].
27. González-Toledo R, Franco M. Is salt sensitive hypertension an inflammatory disease? Role of lymphocytes and macrophages. Arch Cardiol Mex 2012;82:312-9.
28. Ertaş G, Sönmez O, Turfan M, Kul S, Erdoğan E, Tasal A, *et al*. Neutrophil/lymphocyte ratio is associated with thromboembolic stroke in patients with non-valvular atrial fibrillation. J Neurol Sci 2013;324:49-52.
29. Dunn JF, Wu Y, Zhao Z, Srinivasan S, Natah SS. Training the brain to survive stroke. PLoS One 2012;7:e45108.
30. Walter U, Kolbaske S, Patejdl R, Steinhagen V, Abu-Mugheisib M, Grossmann A, *et al*. Insular stroke is associated with acute sympathetic hyperactivation and immunodepression. Eur J Neurol 2013;20:153-9.
31. Choi DH, Lim JH, Lee KH, Kim MY, Kim HY, Shin CY, *et al*. Effect of 710-nm visible light irradiation on neuroprotection and immune function after stroke. Neuroimmunomodulation 2012;19:267-76.
32. Davies-Jones GA. Neurological manifestations of hematological disorders. The neurological aspects of medical disorders. Neurology and General Medicine. 2nd ed. New York: Churchill Livingstone; 1995. p. 219-45.

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