|| ISSN(online): 2589-8698 || ISSN(print): 2589-868X ||
International Journal of Medical and Biomedical Studies
Available Online at www.ijmbs.info
PubMed (National Library of Medicine ID: 101738825)
Index Copernicus Value 2018: 75.71
Original Research Article
Volume 4, Issue 2; February: 2020; Page No. 202-205

SERUM-CORTISOL LEVELS IN SEVERITY OF STROKE

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Article Info: Received 28 January 2020; Accepted 21 February 2020
DOI: https://doi.org/10.32553/ijmbs.v4i2.970
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Conflict of interest: No conflict of interest.

Abstract

Introduction: Cortisol, an important hormone in the hypothalamic pituitary adrenal axis, has important effects on the metabolism of glucose, protein and lipid[i]. A stress response consists of increased levels of cortisol and catecholamines in the 1st weeks after acute stroke. The cortisol response has been observed in cerebral infarction as well as in intracerebral haemorrhage. Change in serum level of cortisol has been reported in patients with ischemic stroke and studies reported that high levels of this hormone are independently associated with increase in ischemic lesion volume. Also it has been observed that cortisol level in patients with ischemic stroke is associated with significantly increased mortality rate. Increase in the circulating levels of catecholamines was shown in insular damage in experimental stroke suggesting this as a mechanism for the cardiac complications associated with stroke.

Patients and Methods: All patients were included in the study who was admitted within 6 hours in the hospital after the episode of stroke. Scandinavian Stroke Scale (SSS)[ii] was monitored in all patients from admission. SSS was performed every 2 hours in the first 24 hours, every 4 hours in the next 48 hours and then daily up to day 7. Blood samples were obtained for routine investigation and estimation of serum cortisol. No patients had blood samples drawn for cortisol determination between 01:00 and 07:00 am.

Results: Mean age was observed in the current series was 72.8 ± 12.54 years. There were 34 (53.1%) male and 30(46.9%) female. SSS was observed to be 36 (21-47) on admission. History of hypertension, History of stroke, Diabetes mellitus and Atrial fibrillation was observed in 38(59.4%), 12(18.8%), 24(37.5%) and 11(17.2%) respectively. In univariate logistic regression analysis of the relations to 7 days of mortality, s-cortisol, SSS on admission, and pulse rate reached a significance level. Age, atrial fibrillation, blood glucose, body temperature 12 h after stroke onset, and the presence of early infarctions signs did not reach a significance level of 0.1 in univariate testing. S-cortisol level was higher in patients with insular involvement, 635 nmol/l, in comparison to patients without insular involvement, 589 nmol/l.

Conclusion: Adrenal glucocorticoid stress response in acute stroke is harmful. High cortisol levels are associated with the poor outcome and mortality of the patients with stroke.

Keywords: Cortisol, HPA, Stroke, SSS

Introduction

Cortisol, an important hormone in the hypothalamic pituitary adrenal axis, has important effects on the metabolism of glucose, protein and lipid[iii]. A stress response consists of increased levels of cortisol and catecholamines in the 1st weeks after acute stroke[iv, v]. Activation of the hypothalamic pituitary adrenal (HPA) axis in acute, severe illness results in elevated cortisol levels. This causes mobilization of glucose from the liver and adipose tissue and the potentiation of cardiovascular output[vi]. Also severe illness correspondingly stimulates higher cortisol concentrations[vii]. Authors have observed that there is association of greater severity of illness with the loss of diurnal variation in cortisol[viii]. It is observed that the ageing is associated with the dysregulation of the HPA axis[ix]. Following an acute stroke, prolonged HPA axis activation may also occur for the specific stroke reasons which include cytokine release following neuronal injury[x]. Also stroke lesion may destroy HPA inhibitory areas of the brain in the frontal or medial temporal lobes[xi].

The cortisol response has been observed in cerebral infarction as well as in intracerebral haemorrhage[xii, xiii]. Cortisol has also been correlated positively to white blood cell count, fibrinogen, and other markers of the inflammatory response after stroke[xiv]. Change in serum level of cortisol has been reported in patients with ischemic stroke and studies reported that a high level of this hormone is independently associated with increase in ischemic lesion volume. Also it has been observed that

cortisol level in patients with ischemic stroke is associated with significantly increased mortality rate[xv, xvi]. Also there ae evidences which shows that prolonged exposure to high cortisol levels is neurotoxic and patients on corticosteroid are shown to have smaller hippocampal volume[xvii]. Some studies suggested that the association between high stress hormone levels and less favourable outcome could be related to cardiac abnormalities resulting from the increased levels of stress-hormones[xviii].

Increase in the circulating levels of catecholamines was shown in insular damage in experimental stroke suggesting this as a mechanism for the cardiac complications associated with stroke[xix].

The aim of the study was to investigate cortisol level and severity of stroke

Patients and Methods:

A total of 68 patients were included in the study. The patients were recruited from the department General Medicine Varun Arjun Medical College and Rohilkhand Hospital Shahjahanpur. Written informed consent was taken from all the patients.

All patients were included in the study who was admitted within 6 hours in the hospital after the episode of stroke. Patients were excluded if age < 18 years, other acute life-threatening diseases and pregnancy.

Three patients were excluded from the study as o9ne patient withdrew consent and two patients had another final diagnose than stroke.

Vital signs such as blood pressure, pulse rate, body temperature were continuously monitored. Scandinavian Stroke Scale (SSS)[xx] was monitored in all patients from admission. SSS was performed every 2 hours in the first 24 hours, every 4 hours in the next 48 hours and then daily up to day 7.

At follow-up of 3 months SSS, blood pressure and pulse rate were assessed. Cerebral infarction or intracerebral haemorrhage was diagnosed on the basis of clinical findings and CT-scan in all patients. Atrial fibrillation was diagnosed by 12-lead ECG on admission or by continuous ECG-monitors. CT scan of each patient was performed and follow-up CT-scan at 7-8 days.

Blood samples were obtained for routine investigation and estimation of serum cortisol. No patients had blood samples drawn for cortisol determination between 01:00 and 07:00 am.

Thus a total 64 study population was obtained after all exclusions and were included in the study.

Statistical analysis

Statistical analysis was performed by SPSS 21.0 for Windows. Normal distribution was assessed. Student's t test was used in comparing means of independent, normally distributed, continuous variables. Stratifications were based on the median of SSS score. Multivariate logistic regression was performed after assessing the normal distribution. A significance level of 0.05 was selected.

Results:

A total of 64 patients were included for final analysis

Table 1: Patients characteristics

N=64	value
Age (mean ± SD)	72.8 ± 12.54
Male (%)	34 (53.1%)
Female (%)	30(46.9%)
SSS (mean / range)	36 (21-47)
History of hypertension (%)	38(59.4%)
History of stroke (%)	12(18.8%)
Diabetes mellitus (%)	24(37.5%)
Atrial fibrillation (%)	11(17.2%)

As described in the table 1, mean age was observed in the current series was 72.8 ± 12.54 years. There were 34 (53.1%) male and 30(46.9%) female. SSS was observed to be 36 (21-47) on admission. History of hypertension, History of stroke, Diabetes mellitus and Atrial fibrillation was observed in 38(59.4%), 12(18.8%), 24(37.5%) and 11(17.2%) respectively.

Table 2: Cortisol levels in patients

Category	Cortisol levels		Number of patients
patients who died within 7 days of stroke onset	1359.4 256.8	±	4
Patients who survived 7 days	624.9 123.9	±	60

Difference-734.500, Standard error- 68.89595%, CI-872.2188 to -596.7812, t-statistic -10.661, DF 62, Significance level-P < 0.0001

In univariate logistic regression analysis of the relations to 7 days of mortality, s-cortisol, SSS on admission, and pulse rate reached a significance level. Age, atrial fibrillation, blood glucose, body temperature 12 h after stroke onset, and the presence of early infarctions signs did not reach a significance level of 0.1 in univariate testing.

S-cortisol level was higher in patients with insular involvement, 635 nmol/l , in comparison to patients

without insular involvement, 589 nmol/l . This result was not statistically significant.

Discussion:

Cortisol was related to body temperature and blood glucose, these are two basic para-clinical measures that have been related to stroke severity in the studies[xxi, xxii]. There was a relation of cortisol to body temperature, lower body temperature in the first hours was related to high cortisol and that higher body temperature later was related to high cortisol[xxiii].

In this study, insular involvement in less severe stroke was associated with a more cortisol response. Our study showed neurological deterioration is related to severe stroke and cortisol levels. Similar observations were shown in other studies[xxiv]. Studies have shown that cortisol was independently associated with death after stroke also found higher cortisol to be independently associated with poorer functional outcome[xxv, xxvi] which was in accordance with our study. Studies also found that cortisol was not an independent predictor of outcome after adjusting for stroke severity[xxvii, xxviii].

Study also investigated the relationship between cortisol and blood pressure and found a positive correlation[xxix]. Studies also reported the relationship between cortisol and length of stay, that a higher cortisol level was associated with a longer length of intensive care unit stay[xxx].

The limitations of our study was that cortisol was analysed only once after admission.

Conclusion:

From these findings we concluded that adrenal glucocorticoid stress response in acute stroke is harmful. High cortisol levels are associated with the poor outcome and mortality of the patients with stroke.

References:

1. Zi WJ, Shuai J. Cortisol as a prognostic marker of short-term outcome in chinese patients with acute ischemic stroke. PLoS One. 2013; 8(9)
2. Lindenstrøm E, Boysen G, Christiansen LW, a` Rogvi Hansen B, Nielsen PW. Reliability of Scandinavian neurological stroke scale. Cerebrovasc Dis 1991;1:103 – 7.
3. Zi WJ, Shuai J. Cortisol as a prognostic marker of short-term outcome in chinese patients with acute ischemic stroke. PLoS One. 2013; 8(9)
4. Myers MG, Norris JW, Hachinski VC, Sole MJ. Plasma norepinephrine in stroke. Stroke 1981;12:200 – 4
5. Oka M. Effect of cerebral vascular accident on the level of 17-hydroxycorticosteroids in plasma. Acta Scand Med 1956;156:221 – 6.
6. Sorrells SF, Sapolsky RM. An inflammatory review of glucocorticoid actions in the CNS.Brain Behav Immun. 2007 Mar; 21(3):259-72.
7. Wade CE, Lindberg JS, Cockrell JL, Lamiell JM, Hunt MM, Ducey J, Jurney TH. Upon-admission adrenal steroidogenesis is adapted to the degree of illness in intensive care unit patients. J Clin Endocrinol Metab. 1988 Aug; 67(2):223-7.
8. Reincke M, Lehmann R, Karl M, Magiakou A, Chrousos GP, Allolio B. Severe illness. Neuroendocrinology. Ann N Y Acad Sci. 1995 Dec 29; 771():556-69.
9. Otte C, Hart S, Neylan TC, Marmar CR, Yaffe K, Mohr DC. A meta-analysis of cortisol response to challenge in human aging: importance of gender. Psychoneuroendocrinology. 2005 Jan; 30(1):80-91.
10. Miller AH, Spencer RL, McEwen BS, Stein M.Depression, adrenal steroids, and the immune system. Ann Med. 1993 Oct; 25(5):481-7.
11. Mitchell AJ. Clinical implications of poststroke hypothalamo-pituitary adrenal axis dysfunction: A critical literature review. J Stroke Cerebrovasc Dis. 1997 Oct-Nov; 6(6):377-88.
12. Meyer JS, Stoica E, Pascu I, Shimazu K, Hartmann A. Chatecholamine concentrations in CSF and plasma of patients with cerebral infarction and haemorrhage. Brain 1973;96:277 – 88.
13. Myers MG, Norris JW, Hachinski VC, Sole MJ. Plasma norepinephrine in stroke. Stroke 1981;12:200 – 4
14. Slowik A, Turaj W, Pankiewicz J, Dziedziz T, Szermer P, Szczudlik A. Hypercortisolemia an acute stroke is related to the inflammatory response. J Neurol Sci 2002;196:27 – 32.
15. Anne M, Juha K, Timo M, Mikko T, Olli V, Kyosti S, et al. Neurohormonal activation in ischemic stroke: effects of acute phase disturbances on long-term mortality. Curr Neurovasc Res. 2007; 4(3) : 170 -5
16. Marklund N, Peltonen M, Nilsson TK, Olsson T. Low and high circulating cortisol levels predict mortality and cognitive dysfunction early after stroke. J Intern Med. 2004; 256(1) : 15 -21
17. Brown ES, J Woolston D, Frol A, Bobadilla L, Khan DA, Hanczyc M, Rush AJ, Fleckenstein J, Babcock E, Cullum CM. Hippocampal volume, spectroscopy, cognition, and mood in patients receiving corticosteroid therapy.. Biol Psychiatry. 2004 Mar 1; 55(5):538-45.

18. Feibel JH, Hardy PM, Campbell GC, Goldstein MN, Joynt RJ. Prognostic value of the stress response following stroke. JAMA 1977;238: 1374 – 6.
19. Smith KE, Hachinski VC, Gibson CJ, Ciriello J. Changes in plasma catecholamine levels after insula damage in experimental stroke. Brain Res 1986;375:182 – 5.
20. Lindenstrøm E, Boysen G, Christiansen LW, a` Rogvi Hansen B, Nielsen PW. Reliability of Scandinavian neurological stroke scale. Cerebrovasc Dis 1991;1:103 – 7.
21. Candelise L, Landi G, Orazio EN, Boccardi E. Prognostic significance of hyperglycemia. Arch Neurol 1985;42:661 – 3.
22. Boysen G, Christensen H. Stroke severity determines body temperature in acute stroke. Stroke 2001;32:413 – 7.
23. Olsson T. Urinary free cortisol excretion shortly after ischaemic stroke. J Int Med 1990;228:177 – 81
24. DeGraba T, Hallenbech JM, Petigrew KD, Dutka AJ, Kelly BJ. Progression in acute stroke. Stroke 1999;30:1208 – 12.
25. Neidert S, et al. Anterior pituitary axis hormones and outcome in acute ischaemic stroke. J Intern Med. 2011;269(4):420–432.
26. Christensen H, Boysen G, Johannesen HH. Serum-cortisol reflects severity and mortality in acute stroke. J Neurol Sci. 2004 Feb 15; 217(2):175-80.
27. Zierath D, et al. Plasma alpha-melanocyte stimulating hormone predicts outcome in ischemic stroke. Stroke. 2011;42(12):3415–3420.
28. Davalos A, et al. Effect of malnutrition after acute stroke on clinical outcome. Stroke. 1996;27(6):1028–1032.
29. Feibel JH, Hardy PM, Campbell RG, Goldstein MN, Joynt RJ.Prognostic value of the stress response following stroke. JAMA. 1977 Sep 26; 238(13):1374-6.
30. Poll EM, et al. Cortisol dynamics in the acute phase of aneurysmal subarachnoid hemorrhage: associations with disease severity and outcome. J Neurotrauma. 2010;27(1):189–195.