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Brain Injury and Cerebral Lateralization

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1. Introduction

The aim of my manuscript will be to explicate the associations among cerebral lateralization, especially left-handedness, decreased longevity, the age of menopause, asymmetries in the bone mineral densities, the asymmetries in common carotid artery intima-media thickness and the risk of sudden death of brain infarction.

2. Left-handedness and decreased longevity

Life span studies^{1,2,3,4,5,6,7,8} have shown that the population percentage of left-handers diminishes steadily, so that they are drastically underrepresented in the oldest age groups. This population trend suggests the reduced longevity of left-handers⁹. Coren and Halpern (1991) suggest that some of the elevated risk for left-handers is apparently due to environmental factors that elevate their accident susceptibility. Also, left-handedness may be a marker for birth stress related neuropathy, developmental delays and irregularities, and deficiencies in the immune system due to the intrauterine hormonal environment. Halpern and Coren (1990) have argued that left-handedness is associated with a younger age at death¹⁰.

Coren (1989) and Halpern and Coren (1991) reported that left-handers were more susceptible to accident-related injuries and more left-handers died in accidents than right-handers^{11,12}. Zverev and Adeloye (2001) reported that left-handedness as a risk factor for head injuries obtained during confrontation activities¹³. Also, an increased prevalence of left hand preference was noted in a population of patients having traumatic brain injuries (MacNiven, 1994)¹⁴. Dane, Karsan and Can (1999) showed that left-handers may be more susceptible to sport-related injuries¹⁵. Graham and Cleveland (1995) and Wright, Williams, Currie and Beattie (1996) suggested that left-handedness appears to be a risk factor for injury among adolescent school athletes^{16,17}. Also, left-handed locomotive drivers were more likely to be involved in accidents (Bhushan & Khan, 2006)¹⁸.

Also, Canakci, Akgul, Akgul, and Canakci (2003) reported that left-handed participants had a significantly higher dental trauma risk than right-handedness¹⁹. Dagistan, Gursay, Cakur, Miloglu, Harorli, and Dane (2009) also studied the relation of left-handedness and risk of dental trauma in professional boxers²⁰. The left-handed boxers had the higher dental trauma risk than right handed ones. Also, the rate of left-handedness was elevated in men diagnosed with fractures than for all other male patients (Stellman, Wynder, DeRose & Muscat, 1997)²¹ and it was demonstrated that the non right-handers were at greater risk for bone breaks and fractures (Coren & Previc, 1996)²².

Coren (1989) suggested that environmental biases against left-handers were the most likely reason for the increased injury risk in left-handers²³. Really, furniture, doors of homes, playground apparatus for children, and automobile designs are based on right-handed world. Also, it has been suggested that the biological differences between right- and left-handers might play a role in increased injury risk of left-handers. Graham, Dick, Rickert and Glenn (1993) reported that the proportion of hospitalized left-handed children for injury treatment was larger than the proportion of right-handers and suggested that left-handedness is a risk factor for unintentional injury in children and adolescents in a pediatric emergency department population²⁴.

It has been claimed that the biological differences in terms of ear advantage^{25,26} (Dane & Bayirli, 1998; Aydin, Dane, Ozturk, Uslu, Gumustekin, & Kirpinar, 2001), eye preference^{27,28,29} (Dane & Gumustekin, 2002; Dane, Gumustekin, Yazici, & Baykal, 2003; Dane, 2006), nasal cycle^{30,31} (Dane & Balci, 2007; Searleman, Hornung, Stein, & Brzuszkiewicz, 2005), and reaction time³² (Dane & Erzurumluoglu, 2003) between right- and left-handers may contribute to the higher rate of injury in left-handers than in right-handers. Because, contradistinctions in intrinsic biological factors such as ear advantage, eye preference, nasal cycle and reaction time in left-handers may be associated with reversal perception of environment in comparison with right-handers and therefore increased accident related injuries.

However, there are also studies which show no elevated injury risk^{33,34} (Peters & Perry, 1991; Hicks, Pass, Freeman, Bautista, & Johnson, 1993). Also, it has been reported that the risk of hand injury was similar for right- and left-handers and individuals with consistent hand preference, regardless of side, were more likely to injure their preferred hand when compared to mixed preference types³⁵ (Porac, 1993).

3. The age of menopause and left-handedness

It was reported that the early menopause occurs more often in left-handed than right-handed women^{36,37,38,39} (Leidy, 1990; Nikolova, Negrev, Stoyanov, & Nikolova 1996; Dane, Reis, & Pasinlioglu, 1999; Dane, Kumtepe, Pasinlioglu, & Aksoy, 2004). It has been suggested that the early menopause in left-handed women may result from the differences in the immune activity between the right- and left-handers³⁹. The cell-mediated immune activity and cell-mediated immune hypersensitivity (tuberculin reaction) were stronger in left-handed than right-handed women³⁹; the age of menopause negatively correlated with tuberculin reaction and percentages of CD4+ and CD8+ lymphocytes³⁹, indicating that autoimmune reactions against hormone receptor sites⁴⁰ (Escobar et al., 1982) or oocytes^{41,42} (Maclaren & Blizzard, 1985; Rabinowe et al., 1989) may cause early menopause. In some studies, it has been also reported that immune activity was powered in left-handed persons than in right-handed ones^{43,44,45,46} (Dane & Tan, 1994; Köylü et al., 1996; Battcock et al., 1990; Ertunç et al., 1997).

4. The bone fractures and left-handedness

The bone mineral density is a marker of the collagen content of bones. Therefore, the higher bone mineral densities in the right-handers compared to the left-handers may be associated with the higher collagen content of bones of the right-handers. Dane, Akar, Hacibeyoglu, and Varoglu (2001), Akar, Sivrikaya, Canikli, and Varoglu (2002) and Gumustekin, Akar,

Dane, Yildirim, Seven, and Varoglu (2004) reported that hand preference may be related to the right-left asymmetry in femoral bone mineral density^{47,48,49}.

In a recent study, the bone mineral densities of both right and left proximal femur regions except Ward's region were higher in right-handed subjects compared to left-handed ones⁵⁰. It can be stated that right-handed subjects have decreased risk of bone fracture than left-handed subjects.

The decreased bone mineral densities in left-handed participants compared to right-handers may be associated with the increased risk of bone breaks and fractures in left-handers^{21, 22} (Stellman, et al., 1997; Coren & Previc, 1996) because the decreased bone mineral density is a good marker of bone fractures. Also, it can be stated that left-handed victims will have more severe consequences during accident.

The decreased bone mineral density in left-handers may also be associated with higher injury risk of smaller traumas. The measured bone mineral densities were within normal ranges in all subjects. The effect sizes of sex and handedness are similar. Therefore, left-handedness and female sex can be considered possible risk factors for bone fractures.

In above mentioned study, the bone mineral densities of both right and left all proximal femur regions were higher in men than in women⁵⁰. The rate of left-handedness was elevated for men diagnosed with bone fractures when compared with all other male patients in a case-control study of 8,801 hospitalized patients with cancer and those with other conditions, but this relation was absent in women patients²¹ (Stellman, et al., 1997). Aggleton, Kentridge, and Neave (1993) and Aggleton, Bland, Kentridge, and Neave (1994) reported that the left-handed men, but not the left-handed women, were more likely to die prematurely in accidents or in warfare^{5,6}. Also, Dagistan, et al. (2009) reported that left-handed boxer men had higher dental trauma risk than right-handed boxers²⁰.

Coren and Previc (1996) reported the results of two studies²². On study 1 retrospective responses were used from medical history checklists completed by 1064 males on active duty with the United States Air Force. The left-handers were at significantly higher risk for knee problems, elbow and shoulder problems, and also swollen and painful joints, although there was no difference in the incidence of broken bones. On study 2 an expanded handedness scale and retrospective reports of both bone breaks and fractures for a predominantly university sample of 1,716 (975 women, 741 men) whose median age was 20 years, indicated that non right-handers were at greater risk for bone breaks and fractures.

In another study⁵¹, ambidextrous men had slightly elevated risk of traffic and home injury, whereas ambidextrous women had slightly elevated risk of work injury compared with right-handers (Pekkarinen, Salminen & Järvelin, 2003).

Boote, Hayes, Abahussin, and Meek (2006) reported that fibrillar collagen in the human cornea and limbus is arranged anisotropically, and left and right corneas are structurally distinct⁵². Also, Dane, Aslankurt, and Yazici (2007) reported the cataracts formed earlier in the dominant eye for both right- and left-eye dominant patients⁵³. This difference by handedness may also be associated with asymmetry in collagen content or structure of the lens by handedness in patients.

As a consequence, the higher susceptibility of the left-handed subjects for accident-related injuries such as bone fractures may be associated with lower bone mineral density in the left-handed participants than in the right-handed. Also, sex related differences in accident-related injuries may be explained by differences in bone mineral density by handedness in women.

5. Asymmetry in carotid artery

Arteriosclerosis is a chronic disease of the arterial system characterized by abnormal thickening and hardening of the vessel walls. In arteriosclerosis, the tunica intima undergoes a series of changes that decrease the artery's ability to change lumen size. Smooth muscle cells and collagen fibers migrate into the tunica intima, causing it to stiffen and thicken. This process gradually narrows the arterial lumen. Common carotid intima-media thickness (CCA-IMT) has been shown to be associated with atherosclerosis and stroke^{54,55,56,57,58,59,60,61,62}. Increased CCA-IMT determined by B-mode ultrasonography has been shown to be directly associated with an increased risk of myocardial infarction and stroke in older adults without a previous history of cardiovascular disease^{62,63}.

It has been reported that left-handed, not right-sided, brain infarction was associated with increased risk of sudden death and left-handed or ambidextrous patients have a lower risk of sudden death than right-handed patients⁶⁴.

Rodriguez-Hernandez et al. (2003) compared left and right common carotid artery intima-media thickness as measured by B-mode ultrasonography and reported that the difference between both sides was significant (left, 0.75 ± 0.11 mm, right, 0.71 ± 0.11 mm)⁶⁵. Also, they reported that the incidence of nonlacunar cerebrovascular stroke was significantly higher at the left side and suggested a predilection for cerebrovascular disease at the left side, which may be related to greater hemodynamic stress and intimal damage in the left carotid artery. Also, Denairo et al. (2000) have reported that CCA-IMT was lower on the right side than on the left side in both sexes⁶⁶.

Bogren et al. (1994) have reported that all right-handed subjects in their study had higher flow rates in the left internal carotid artery than in the right, and all left-handed subjects had higher flow rates in the right internal carotid artery than in the left⁶⁷.

In the study performed by Onbas et al. (2007), there was a difference between intima media thicknesses of the left and right common carotid artery, with higher values on the left side⁶⁸. In some earlier studies, CCA-IMT was also higher on left side than on right side^{65,66,69,70}.

Rodriguez-Hernandez et al. (2003) reported that the incidence of nonlacunar cerebrovascular stroke was significantly higher at the left side⁶⁵. Algra et al. (2003) reported that left-sided, not right-sided, brain infarction was associated with increased risk of sudden death⁶⁴. In the light of these studies, it can be speculated that there is a predilection for cerebrovascular disease at the left side, which may be related to greater hemodynamic stress and intimal damage in the left carotid artery.

But, a common pathophysiological mechanism associated with the higher IMT in the left CCA and the more frequent occurrence of stroke in the left hemisphere is unclear. The higher IMT in the left CCA may result from the fact that the cell-mediated (T cell-dependent) hypersensitivity was higher in the left side of the body than the right side^{71,72,73}.

Because atherosclerosis is a chronic inflammatory disease^{74,75}, its pathogenesis involves disturbed lipoprotein metabolism, the formation of proinflammatory lipid peroxidation products, and the host's immune responses^{76,77}. Oxidized LDL is present in atherosclerotic lesions and contains a wide variety of lipid peroxidation products, which in turn can form neo-self determinants recognized by specific innate and adaptive immune responses^{78,79}. During atherogenesis, LDL is oxidized, generating various oxidation-specific neopeptides, such as malondialdehyde-modified LDL or the phosphorylcholine head group of oxidized phospholipids. These epitopes are recognized by both adaptive T cell-dependent and innate T cell-independent type 2 immune responses^{80,81}.

In the study performed by Onbas et al. (2007), the difference in CCA-IMT between right and left sides was statistically significant in the left handers, but not in the right-handers⁸². The greater difference in the left-handers may be due to a more active and effective immune system in the left-handers than in the right-handers^{39, 43, 44, 45, 46}.

Also, in the study performed by Onbas et al. (2007), handedness related differences in CCA-IMT demonstrated. Both right and left CCA-IMTs were lower in the left-handers than in the right-handers. They speculated that a lower risk of sudden death in the left-handed or ambidextrous patients than the right-handed patients in brain infarction⁶⁴, may be associated with the lower IMT in the left-handers. The lower CCA-IMT on both sides for the left-handers may result from the handedness related differences in carotid artery blood flow in healthy subjects measured with MR velocity mapping⁶⁷.

6. References

- [1] Porac C, Coren S, Duncan P. Life-span age trends in laterality. *Journal of Gerontology*, 1980, 35, 715-721.
- [2] Porac C, Coren S. *Lateral preferences and human behavior*. New York: Springer. 1981.
- [3] Halpern DF, Coren S. Do right-handers live longer? *Nature*, 1988, 333, 213.
- [4] Coren S. *The left hander syndrome: the causes and consequences of left-handedness*. New York: Free Press. 1992.
- [5] Aggleton JP, Bland JM, Kentridge RW, Neave NJ. Handedness and longevity: an archival study of cricketers. *British Medical Journal*, 1994, 309, 1681-1684.
- [6] Aggleton JP, Kentridge RW, Neave NJ. Evidence for longevity differences between left handed and right handed men: an archival study of cricketers. *Journal of Epidemiology and Community Health*, 1993, 47, 206-209.
- [7] Coren S. The diminished number of older left-handers: differential mortality or social-historical trend? *International Journal of Neuroscience*, 1994, 75, 1-8.
- [8] Davis A, Annett M. Handedness as a function of twinning, age and sex. *Cortex*, 1994, 30, 105-111.
- [9] Coren S, Halpern DF. Left-handedness: a marker for decreased survival fitness. *Psychol Bull.* 1991 Jan;109(1):90-106.
- [10] Halpern DF, Coren S. Laterality and longevity: is left-handedness associated with a younger age at death? In S. Coren (Ed.), *Left-handedness: behavioral implications and anomalies*. Amsterdam: Elsevier Science. Pp. 1990, 509-545.
- [11] Coren, S. (1989) Left-handedness and accident related injury risk. *American Journal of Public Health*, 79, 1040-1041.
- [12] Halpern, D. F., & Coren, S. (1991) Handedness and life span. *New England Journal of Medicine*, 324, 998.
- [13] Zverev, Y., & Adeloje. A. (2001) Left-handedness as a risk factor for head injuries. *East African Medical Journal*, 78, 22-24.
- [14] MacNiven, E. (1994) Increased prevalence of left-handedness in victims of head trauma. *Brain Injury*, 8, 457-462.
- [15] Dane, S., Karsan, O., & Can, S. (1999) Sports injuries in right and left handers. *Perceptual and Motor Skills*, 89, 846-848.
- [16] Graham, C. J., & Cleveland, E. J. (1995) Left-handedness as an injury risk factor in adolescents. *Journal of Adolescent Health*, 16, 50-52.

- [17] Wright, P., Williams, J., Currie, C., & Beattie, T. (1996) Left-handedness increases injury risk in adolescent girls. *Perceptual and Motor Skills*, 82: 855-858.
- [18] Bhushan, B., & Khan, S. M. (2006) Laterality and accident proneness: a study of locomotive drivers. *Laterality*, 11, 395-404.
- [19] Canakci, V., Akgul, H. M., Akgul, N., & Canakci, C. F. (2003) Prevalence and handedness correlates of traumatic injuries to the permanent incisors in 13-17-year-old adolescents in Erzurum, Turkey. *Dental Traumatology*, 19, 248-254.
- [20] Dagistan, D., Gursoy, G., Cakur, B., Miloglu, O., Harorli, E., & Dane, S. (2009) Handedness differences in dental traumatic injuries of boxers. *Turkish Journal of Medical Science*, 39(5), 803-807.
- [21] Stellman, S. D., Wynder, E. L., DeRose, D. J., & Muscat, J. E. (1997) The epidemiology of left-handedness in a hospital population. *Annals of Epidemiology*, 7, 167-171.
- [22] Coren, S., & Previc, F. H. (1996) Handedness as a predictor of increased risk of knee, elbow, or shoulder injury, fractures and broken bones. *Laterality*, 1, 139-152.
- [23] Coren, S. (1989) Left-handedness and accident related injury risk. *American Journal of Public Health*, 79, 1040-1041.
- [24] Graham, C. J., Dick, R., Rickert, V. I., & Glenn, R. (1993) Left-handedness as a risk factor for unintentional injury in children. *Pediatrics*, 92(6), 823-826.
- [25] Dane, S., & Bayirli, M. (1998) Correlations between hand preference and durations of hearing for right and left ears in young healthy subjects. *Perceptual and Motor Skills*, 86, 667-672.
- [26] Aydin, N., Dane, S., Ozturk, I., Uslu, C., Gumustekin, K., & Kirpinar, I. (2001) Left ear (right temporal hemisphere) advantage and left temporal hemispheric dysfunction in schizophrenia. *Perceptual and Motor Skills*, 93, 230-238.
- [27] Dane, S., & Gumustekin K. (2002) Correlation between hand preference and distance of focusing points of two eyes in the horizontal plane. *International Journal of Neuroscience*, 112, 1141-1147.
- [28] Dane, S., Gumustekin, K., Yazici, A. T., & Baykal, O. (2003) Correlation between hand preference and intraocular pressure from right- and left-eyes in right- and left-handers. *Vision Research*, 43, 405-408.
- [29] Dane, S. (2006) Sex and eyedness in a sample of Turkish high school students. *Perceptual and Motor Skills*, 103, 89-90.
- [30] Dane, S., & Balci, N. (2007) Handedness, eyedness and nasal cycle in children with autism. *International Journal of Developmental Neuroscience*, 25, 223-226.
- [31] Searleman, A., Hornung, D. E., Stein, E., & Brzuszkiewicz, L. (2005) Nostril dominance: differences in nasal airflow and preferred handedness. *Laterality*, 10, 111-120.
- [32] Dane, S., & Erzurumluoglu, A. (2003) Sex and handedness differences in eye-hand visual reaction times in handball players. *International Journal of Neuroscience*, 113, 923-929.
- [33] Peters, M., & Perry, R. (1991) No link between left-handedness and maternal age and no elevated accident rate in left-handers. *Neuropsychologia*, 29, 1257-1259.
- [34] Hicks, R. A., Pass, K., Freeman, H., Bautista, J., & Johnson, C. (1993) Handedness and accidents with injury. *Perceptual and Motor Skills*, 77, 1119-1122.

- [35] Porac, C. (1993) Hand preference and the incidence of accidental unilateral hand injury. *Neuropsychologia*, 31, 335-362.
- [36] Leidy, L. E. (1990). Early age at menopause among left-handed women. *Obstetrics and Gynecology*, 76, 1111-1114.
- [37] Nikolova, P., Negrev, N., Stoyanov, Z., & Nikolova, R. (1996). Functional brain asymmetry, handedness and age characteristics of climacterium in women. *International Journal of Neuroscience*, 86, 143-149.
- [38] Dane, S., Reis, N., & Pasinlioglu, T. (1999). Left-handed women have earlier age of menopause. *Journal of Basic and Clinical Physiology and Pharmacology*, 10, 147-150.
- [39] Dane, S., Kumtepe, Y., Pasinlioglu, T., & Aksoy, A. (2004) Relationship between age of menopause and cell-mediated immune hypersensitivity in right- and left-handed women. *International Journal of Neuroscience*, 114, 651-657.
- [40] Escobar, M. E., Cigorruga, S. E., Chiauzzi, V. A., Charreau, E. H., & Rivarola, M. A. (1982). Development of the gonadotrophic resistant ovary syndrome in myasthenia gravis: Suggestion of similar autoimmune mechanisms. *Acta Endocrinologica*, 99, 431-436.
- [41] Maclaren, N. K., & Blizzard, R. M. (1985). Adrenal autoimmunity and autoimmune polyglandular syndromes. In N. R. Rose & I. R. Mackay (Ed.), *The autoimmune diseases* (pp. 201-225). New York: Academic Press.
- [42] Rabinowe, S. L., Ravnkar, V. A., Dib, S. A., George, K. L., & Dluhy, R. G. (1989). Premature menopause: Monoclonal antibody defined T lymphocyte abnormalities and antiovarian antibodies. *Fertility and Sterility*, 51, 450-454.
- [43] Dane, S., & Tan, Ü. (1994). Tuberculin reaction is stronger in left-handed than right-handed children. *Turkish Journal of Medical Science*, 21, 23-25.
- [44] Köylü, H., Sengül, A., Özlan, L., Dalçık, H., & Etlik, Ö. (1996). Lymphocyte subsets in cerebral lateralization. *Turkish Journal of Medical Science*, 26, 249-251.
- [45] Battcock, T. M., Finn, R., Barnes, R. M. R. (1990). Observations on herpes zoster: 1. Residual scarring and post-herpetic neuragia; 2. Handedness and the risk of infection. *British Journal of clinical Practice*, 44, 596-598.
- [46] Ertunç, V., Dane, S., Karakuzu, A., & Deniz, O. (1997). Higher herpes zoster infection frequency in right-handed patients and more appearance in left body side of females. *Acta Dermato-Venerologica*, 77, 245.
- [47] Dane, S., Akar, S., Hacibeyoglu, I., & Varoglu, E. (2001) Differences between right- and left-femoral bone mineral densities in right- and left-handed men and women. *International Journal of Neuroscience*, 111, 187-192.
- [48] Akar, S., Sivrikaya, H., Canikli, A., & Varoğlu, E. (2002) Lateralized mineral content and density in distal forearm bones in right-handed men and women: relation of structure to function. *International Journal of Neuroscience*, 112, 301-311.
- [49] Gumustekin, K., Akar, S., Dane, S., Yildirim, M., Seven, B., & Varoglu, E. (2004) Handedness and bilateral femoral bone densities in men and women. *International Journal of Neuroscience*, 114, 1533-1547.
- [50] Sahin A, Dane S, Seven B, Akar S, Yildirim S. Differences by sex and handedness in right and left femur bone mineral densities. *Percept Mot Skills*. 2009 Dec;109(3):824-30.

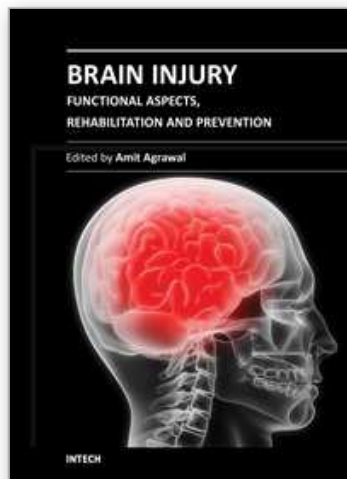
- [51] Pekkarinen, A., Salminen, S., & Järvelin, M. R. (2003) Hand preference and risk of injury among the Northern Finland birth cohort at the age of 30. *Laterality*, 8, 339-346.
- [52] Boote, C., Hayes, S., Abahussin, M., & Meek, K. M. (2006) Mapping collagen organization in the human cornea: left and right eyes are structurally distinct. *Investigative Ophthalmology & Visual Science*, 47, 901-908.
- [53] Dane, S., Aslankurt, M., Yazici, A. T. (2007) The formation of cataract is earlier in the dominant eye. *Laterality*, 12(2), 167-171.
- [54] Ebrahim S, Papacosta O, Whincup P, Wannamethee G, Walker M, Nicolaides AN, Dhanjil S, Griffin M, Belcaro G, Rumley A, Lowe GD. Carotid plaque, intima media thickness, cardiovascular risk factors, and prevalent cardiovascular disease in men and women: the British Regional Heart Study. *Stroke*. 1999 Apr;30(4): 841-50.
- [55] Zannad F, Visvikis S, Gueguen R, Sass C, Chapet O, Herbeth B, Siest G. Genetics strongly determines the wall thickness of the left and right carotid arteries. *Hum Genet*. 1998 Aug;103(2):183-8.
- [56] Iannuzzi A, Wilcosky T, Mercuri M, Rubba P, Bryan FA, Bond MG. Ultrasonographic correlates of carotid atherosclerosis in transient ischemic attack and stroke. *Stroke*. 1995 Apr;26(4):614-9.
- [57] Cuspidi C, Lonati L, Sampieri L, Pelizzoli S, Pontiggia G, Leonetti G, Zanchetti A. Left ventricular concentric remodelling and carotid structural changes in essential hypertension. *J Hypertens*. 1996 Dec;14(12):1441-6.
- [58] Allan PL, Mowbray PJ, Lee AJ, Fowkes FG. Relationship between carotid intima-media thickness and symptomatic and asymptomatic peripheral arterial disease. The Edinburgh Artery Study. *Stroke*. 1997 Feb;28(2):348-53.
- [59] Bots ML, Hoes AW, Koudstaal PJ, Hofman A, Grobbee DE. Common carotid intima-media thickness and risk of stroke and myocardial infarction: the Rotterdam Study. *Circulation*. 1997 Sep 2;96(5):1432-7.
- [60] Veller MG, Fisher CM, Nicolaides AN, Renton S, Geroulakos G, Stafford NJ, Sarker A, Szendro G, Belcaro G. Measurement of the ultrasonic intima-media complex thickness in normal subjects. *J Vasc Surg*. 1993 Apr;17(4):719-25.
- [61] Cupini LM, Pasqualetti P, Diomedes M, Vernieri F, Silvestrini M, Rizzato B, Ferrante F, Bernardi G. Carotid artery intima-media thickness and lacunar versus nonlacunar infarcts. *Stroke*. 2002 Mar;33(3):689-94.
- [62] O'Leary DH, Polak JF, Kronmal RA, Manolio TA, Burke GL, Wolfson SK Jr. Carotid-artery intima and media thickness as a risk factor for myocardial infarction and stroke in older adults. Cardiovascular Health Study Collaborative Research Group. *N Engl J Med*. 1999 Jan 7;340(1):14-22.
- [63] Baldassarre D, Amato M, Bondioli A, Sirtori CR, Tremoli E. Carotid artery intima-media thickness measured by ultrasonography in normal clinical practice correlates well with atherosclerosis risk factors. *Stroke*. 2000 Oct;31(10):2426-30.
- [64] Algra A, Gates PC, Fox AJ, Hachinski V, Barnett HJ; North American Symptomatic Carotid Endarterectomy Trial Group. Side of brain infarction and long-term risk of sudden death in patients with symptomatic carotid disease. *Stroke*. 2003 Dec;34(12):2871-5. Epub 2003 Nov 20.

- [65] Rodríguez Hernández SA, Kroon AA, van Boxtel MP, Mess WH, Lodder J, Jolles J, de Leeuw PW. Is there a side predilection for cerebrovascular disease? *Hypertension*. 2003 Jul;42(1):56-60. Epub 2003 Jun 16.
- [66] Denarié N, Gariepy J, Chironi G, Massonneau M, Laskri F, Salomon J, Levenson J, Simon A. Distribution of ultrasonographically-assessed dimensions of common carotid arteries in healthy adults of both sexes. *Atherosclerosis*. 2000 Feb;148(2):297-302.
- [67] Bogren HG, Buonocore MH, Gu WZ. Carotid and vertebral artery blood flow in left- and right-handed healthy subjects measured with MR velocity mapping. *J Magn Reson Imaging*. 1994 Jan-Feb;4(1):37-42.
- [68] Onbaş O, Dane S, Kantarci M, Koplay M, Alper F, Okur A. Clinical importance of asymmetry and handedness differences in common carotid artery intima-media thickness. *Int J Neurosci*. 2007 Apr;117(4):433-41.
- [69] Simon A, Gariepy J, Chironi G, Megnien JL, Levenson J. Intima-media thickness: a new tool for diagnosis and treatment of cardiovascular risk. *J Hypertens*. 2002 Feb;20(2):159-69.
- [70] Lemne C, Jogestrand T, de Faire U. Carotid intima-media thickness and plaque in borderline hypertension. *Stroke*. 1995 Jan;26(1):34-9.
- [71] Dane S, Erdem T, Gümüştekin K. Cell-mediated immune hypersensitivity is stronger in the left side of the body than the right in healthy young subjects. *Percept Mot Skills*. 2001 Oct;93(2):329-32.
- [72] Gontova IA, Abramov VV, Kozlov VA. The role of asymmetry of nervous and immune systems in the formation of cellular immunity of (CBaxC57Bl/6) F1 mice. *Neuroimmunomodulation*. 2004;11(6):385-91.
- [73] Gontova IA, Abramov VV, Kozlov VA. Asymmetry of delayed type hypersensitivity reaction in mice. *Bull Exp Biol Med*. 2003 Jan;135(1):67-9.
- [74] Steinberg D. Atherogenesis in perspective: hypercholesterolemia and inflammation as partners in crime. *Nat Med*. 2002 Nov;8(11):1211-7. No abstract available.
- [75] Glass CK, Witztum JL. Atherosclerosis. the road ahead. *Cell*. 2001 Feb 23;104(4):503-16.
- [76] Binder CJ, Hartvigsen K, Chang MK, Miller M, Broide D, Palinski W, Curtiss LK, Corr M, Witztum JL. IL-5 links adaptive and natural immunity specific for epitopes of oxidized LDL and protects from atherosclerosis. *J Clin Invest*. 2004 Aug;114(3):427-37.
- [77] Binder CJ, Chang MK, Shaw PX, Miller YI, Hartvigsen K, Dewan A, Witztum JL. Innate and acquired immunity in atherogenesis. *Nat Med*. 2002 Nov;8(11):1218-26.
- [78] Hansson GK, Libby P, Schönbeck U, Yan ZQ. Innate and adaptive immunity in the pathogenesis of atherosclerosis. *Circ Res*. 2002 Aug 23;91(4):281-91.
- [79] Binder CJ, Chang MK, Shaw PX, Miller YI, Hartvigsen K, Dewan A, Witztum JL. Innate and acquired immunity in atherogenesis. *Nat Med*. 2002 Nov;8(11):1218-26.
- [80] Hansson GK, Libby P, Schönbeck U, Yan ZQ. Innate and adaptive immunity in the pathogenesis of atherosclerosis. *Circ Res*. 2002 Aug 23;91(4):281-91.
- [81] Binder CJ, Hartvigsen K, Chang MK, Miller M, Broide D, Palinski W, Curtiss LK, Corr M, Witztum JL. IL-5 links adaptive and natural immunity specific for epitopes of oxidized LDL and protects from atherosclerosis. *J Clin Invest*. 2004 Aug;114(3):427-37.

- [82] Onbaş O, Dane S, Kantarci M, Koplay M, Alper F, Okur A. Clinical importance of asymmetry and handedness differences in common carotid artery intima-media thickness. *Int J Neurosci*. 2007 Apr;117(4):433-41.

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The present two volume book "Brain Injury" is distinctive in its presentation and includes a wealth of updated information on many aspects in the field of brain injury. The Book is devoted to the pathogenesis of brain injury, concepts in cerebral blood flow and metabolism, investigative approaches and monitoring of brain injured, different protective mechanisms and recovery and management approach to these individuals, functional and endocrine aspects of brain injuries, approaches to rehabilitation of brain injured and preventive aspects of traumatic brain injuries. The collective contribution from experts in brain injury research area would be successfully conveyed to the readers and readers will find this book to be a valuable guide to further develop their understanding about brain injury.

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