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The correlation of number of risk factors for stroke and occurrence of anterior versus posterior circulation infarction

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Abstract
Background: Stroke which is a manifestation of cerebrovascular disease is noted as a leading cause of death worldwide. Identification of risk factors associated with stroke is an important contributing factor to consider. Few studies mentioned their association with the anterior circulation (AC) versus posterior circulation (PC) stroke as these have different pathogenesis.
Aim: to evaluate the number of risk factors and their correlation with occurrence of AC versus PC brain infraction.
Methods: In this observational cross-sectional study, we evaluated 71 (37 male, 34 female) consecutive patients presented with ischemic stroke. Among them 51 patients were diagnosed as AC infarction and 20 patients had PC infarction. We divided those patients into two age groups: below 65 and above 65 years old. Pre-stroke risk factors were recorded by the experts.
Results: Regarding the age group distribution, patients having AC infarction below 65 years old were 21 (41.2%) and above 65 were 30 (58.8%), while those with PC infarction below 65 were 10 (50%) and above 65 were also 10 (50%), *p* 0.882. After estimating the impact of the number of risk factors for each patient in both groups, there was significant difference between association of multiple risk factors with PC infarction patients, 14 out of 20 (70%), versus AC infarction patients, 23 out of 51 (45%), *p* 0.034.
Conclusion: PC infarction was significantly associated with multiple risk factors more than AC infarction. However, the impact of risk factors on AC and PC strokes and the prevalence were nearly equal in both sexes.

Keywords: stroke, risk factor, posterior circulations stroke, anterior circulations stroke

Introduction

Cerebrovascular disease is noted as the leading cause of death worldwide since 1990 and ranks first among the neurological diseases in human adult life. At least about half of the percentage of neurological diseases are of this type [1]. Among them, mortality over the first year after the first stroke is approximately 20%. The economic and social burdens of stroke, however, are not consequences of mortality; but it causes disability in adults having a stroke which utilizes a large proportion of healthcare resources [2]. These stroke survivors have to adapt to a life with restrictions in activities of daily living as a consequence of cerebrovascular disease may be due to physical and mental disability occurred by stroke-induced brain damage [3].

A stroke is a clinical syndrome characterized by rapidly developing symptoms and/or signs of focal, and on occasion global (for patients in a deep coma and those with subarachnoid hemorrhage), loss of cerebral function, with symptoms lasting more than 24 hours or leading to death, with no apparent cause other than that of vascular origin [4]. It is a heterogeneous disease and refers to an umbrella of conditions. It was observed that it occurs mostly due to cerebral infarction, primary intracerebral hemorrhage (PICH), intraventricular hemorrhage, and most cases of subarachnoid hemorrhage (SAH); it excludes subdural hemorrhage, epidural hemorrhage, or intracerebral hemorrhage (ICH) or infarction caused by infection or tumor [1].

On the pathological background for stroke, it is a disturbance of cerebral blood circulation which may be either ischemic or hemorrhagic [1]. Ischemic stroke is caused by a transient or permanent reduction of blood flow confined to the territory of a cerebral artery, typically by embolic or thrombotic obstruction. In the Western world, ischemic stroke comprises 80–85%, while primary intracerebral hemorrhages, subarachnoid hemorrhages, and sinus thrombosis remaining 15–20% [5].

Posterior circulation strokes represent approximately 20% of all ischemic stroke accounts for high mortality and morbidity [6, 7]. Based on the clinical studies, posterior circulation stroke develops significant brain injury, neurologic dysfunction, or death, as it consists of the posterior pole of the brain, parts of the basal ganglia, cerebellum, brainstem, and spinal cord [5]. In this way, PCI has various presentations that differ from ACI in terms of etiology and clinical features [8]. The previously reported annual incidence of transient ischemic attacks (TIA) within the vertebrobasilar distribution was 20/100,000 population for men, 10/100,000 for women, and 14/100,000 for both sexes [9].

Exposure of persons to major cardiovascular risk factors for stroke is considered a very important contributing factor when predicting the future stroke burden. Through epidemiological research, numerous risk factors have been identified which are associated with an increased risk of stroke. These risk factors are important for the primary and secondary prevention of stroke [10]. Likewise, traditional vascular risk factors seem to exert erratic magnitudes of risk for other major vascular events. Some of the earlier studies have also suggested that it may exert a risk for ischemic stroke within cerebral arterial territories like hypercholesterolemia, it is a stronger risk factor in

myocardial infarction than ischemic stroke [11]. Thus, stroke is ideally suited for prevention as it is characterized by a high prevalence of disease, a substantial number of modifiable risk factors, therapies that have proven to reduce stroke risk, a high rate of disability, and a high economic burden [12].

Several observational epidemiological studies have led to the documentation of risk factors for stroke, and clinical trials have established a strong armamentarium of preventions for first or recurrent stroke. It was observed that at a population point of view smoking and blood pressure are two important modifiable cerebrovascular risk factors due to high prevalence in the society [13]. Other major modifiable risk factors are diabetes mellitus, hyperlipidemia (Hypercholesterolemia), alcohol consumption, obesity, ischemic heart disease [14]. While age is the strongest non-modifiable risk factor associated with stroke. Though there is information available about the risk factors, there is no data presented on the risk factors and their association with an infraction [10]. Thus, we sought to explore the number and the extent of risk factors and their association with the occurrence of anterior circulation infarction versus posterior circulation infarction.

Patients and Methods

In this observational cross-sectional study, we evaluated 71 consecutive patients. The participants were recruited in the neurological word at Al-Hussain teaching hospital throughout the year 2018. Out of those 71 patients, 37 patients were male and 34 were female. Among them 51 patients were diagnosed clinically and radiologically as Anterior Circulation Infarction (ACI) and 20 patients were diagnosed as Posterior Circulation Infarction (PCI). We divided the patients into two groups according to their age: below 65 years old and above 65 years old. Inclusion criteria was any patient with new ischemic stroke regardless of their age. Exclusion criteria were patients with hemorrhagic stroke, renal failure, liver failure, heart failure and arrhythmia.

According to standard procedure patients were examined and confirmed for ischemic stroke by imaging studies, in addition to full medical history and physical examination including measuring vital signs, weight and height. Obesity was defined as body mass index (BMI) of 30 and above. Diabetic patients were considered when the patient was on antidiabetic or his blood sugar reading was high along with high HbA1c and consistent with WHO criteria for diagnosing Diabetes Mellitus (DM) [15]. Similarly, patients having hypertension and hyperlipidemia were considered if they are on antihypertensive drug or lipid lowering drugs respectively, or when their values exceeding the normal range according to American College of Cardiology (ACC)/ American Heart Association (AHA) guidelines [16]. Patients were also evaluated for current smoking habits, and the presence of atrial fibrillation, valvular heart disease and heart failure.

Consent was endorsed from each patient along with interview and examination for his neurologic deficit and asked about the risk factors for stroke. All patients were subjected to examination by neurologist at time of admission for the confirmation of ACI or PCI using computerized tomography scan (CT) and magnetic resonance imaging (MRI). All patients underwent an electrocardiogram (ECG), echocardiography and with frequent checking of blood pressure. Blood samples were taken from all patients to measure complete blood count, fasting and random blood sugar, lipid profile, liver enzymes, renal indices, and electrolytes.

Statistical analysis of the obtained data was carried out using GraphPad quick test. Categorical variables were expressed in numbers and percentage and were assessed statistically using Fisher's exact test. P-value below 0.05 was considered as a cut point for statistical significance.

Results

The demographic distribution of the studied patients revealed that patients with Anterior Circulation Infarction (ACI) below 65 years age group was 21 patients (13 male and 8 female), and above 65 years age group was 30 patients (12 male and 18 female), while those with Posterior Circulation Infarction (PCI) below 65 years age group was 10 patients (7 male and 3 female), and above 65 years age group was 10 patients (4 male and 6 female), as expressed in table 1 and figure 1.

The distribution of the common modifiable risk factors among patients with anterior and posterior circulation infarction is demonstrated in table 2 and figure 2. It was noticed that the most common risk factor associated with stroke in this study was hypertension, followed by obesity then dyslipidemia, diabetes mellitus, and finally current smoking. There were no significant differences between these risk factors and occurrence of AC vs PC infarctions except for diabetes mellitus which was significantly associated with PC more than AC infarctions (p-value 0.002).

After evaluating the number of risk factors estimated for each patient in both groups, we found that among total patients, those patients with PCI were significantly associated with multiple risk factors more than those with ACI.

As illustrated in table 3 and figure 3, it was noted that among patients with ACI, 28 patients (55%) had single risk factor and 23 patients (45%) had multiple risk factors, while among patients with PCI, 5 patients (25%) had single risk factor and 15 patients (75%) had multiple risk factors were observed. Overall, the relation of the presence of single or multiple risk factors among patients with ACI versus PCI stroke was statistically significant with *p*-value 0.0339.

We have also observed the influence of different age groups on the relation of the number of risk factors on patients having ACI vs PCI. The correlation of single and multiple risk factors in patients below 65-year age group having ACI vs PCI were statistically significant with the *p*-value 0.023. While the correlation in the group above 65-year age was statistically insignificant with the *p*-value 0.47.

Table 1: Demographic distribution of the study patients

Age	Sex	ACI* (n=51)	PCI* (n=20)	Total^ (n=71)
Below 65 Y	M	13 (25.5%)	7 (35%)	20 (28.2%)
	F	8 (15.7%)	3 (15%)	11 (15.5%)
Above 65 Y	M	12 (23.5%)	4 (20%)	16 (22.5%)
	F	18 (35.3%)	6 (30%)	24 (33.8%)

*ACI: Anterior Circulation Infarction, PCI: Posterior Circulation Infarction

^*There are no significant differences (p-value 0.882)*

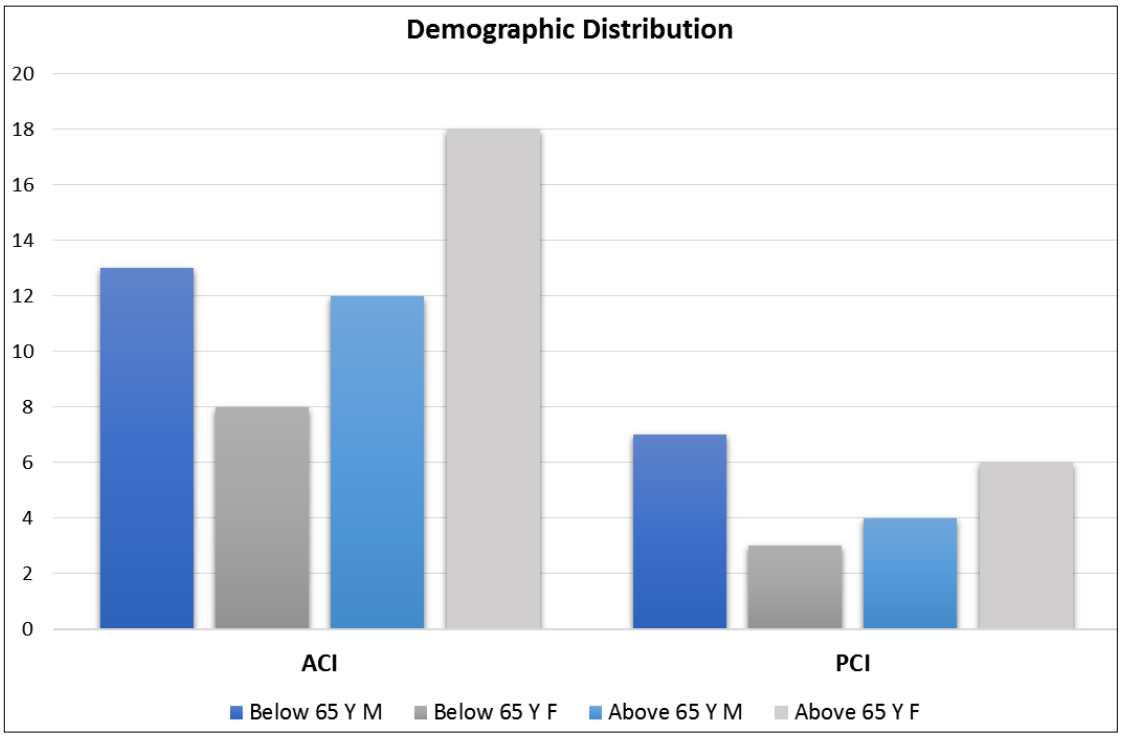

Fig 1: Demographic distribution of the study patients

Table 2: Frequency of modifiable risk factors in patients with anterior circulation versus posterior circulation infarction

Risk Factors	ACI (n=51)	PCI (n=20)	Total (n=71)	*P-value*
HT	33 (64.7%)	17 (85%)	50 (70.4%)	0.147
Obesity	31 (60.8%)	16 (80%)	47 (66.2%)	0.166
Dyslipidemia	24 (47.1%)	13 (65%)	37 (52.1%)	0.197
DM	15 (29.5%)	14 (70%)	29 (40.8%)	0.002
Smoking	13 (25.5%)	8 (40%)	21 (29.6%)	0.257

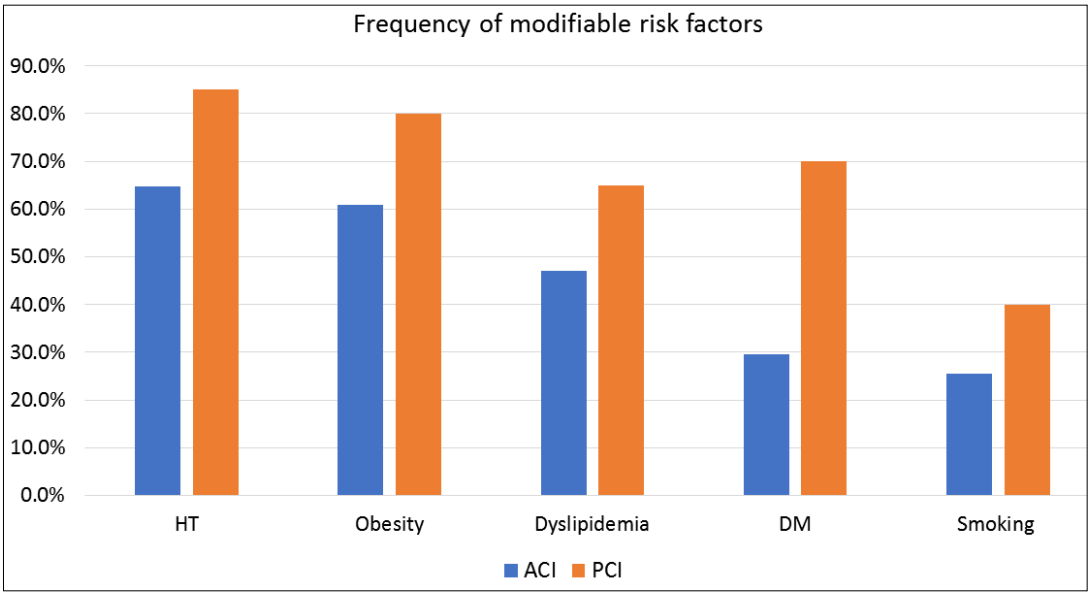

Fig 2: Frequency of modifiable risk factors in patients with anterior circulation versus posterior circulation infarction

Table 3: The relation of single and multiple risk factors in patients with anterior circulation versus posterior circulations infarction

No. of Risk Factors	ACI (n=51)			PCI (n=20)			Total (n=71)
	Below 65	Above 65	Total	Below 65	Above 65	Total	
Single RF	14 (67%) [a]	14 (47%) [b]	28 (55%)*	2 (20%) [a]	3 (40%) [b]	5 (25%)*	33 (46.5%)
Multiple RF	7 (33%) [a]	16 (53%) [b]	23 (45%)*	8 (80%) [a]	7 (60%) [b]	15 (75%)*	38 (53.5%)
Total	21 (100%)	30 (100%)	51 (100%)	10 (100%)	10 (100%)	20 (100%)	71 (100%)

[a] Significant difference between patients below 65 (P-value 0.023), [b] No Significant difference between patients above 65 (P-value 0.47),
* Significant difference between total patients in both groups (P-value 0.034)

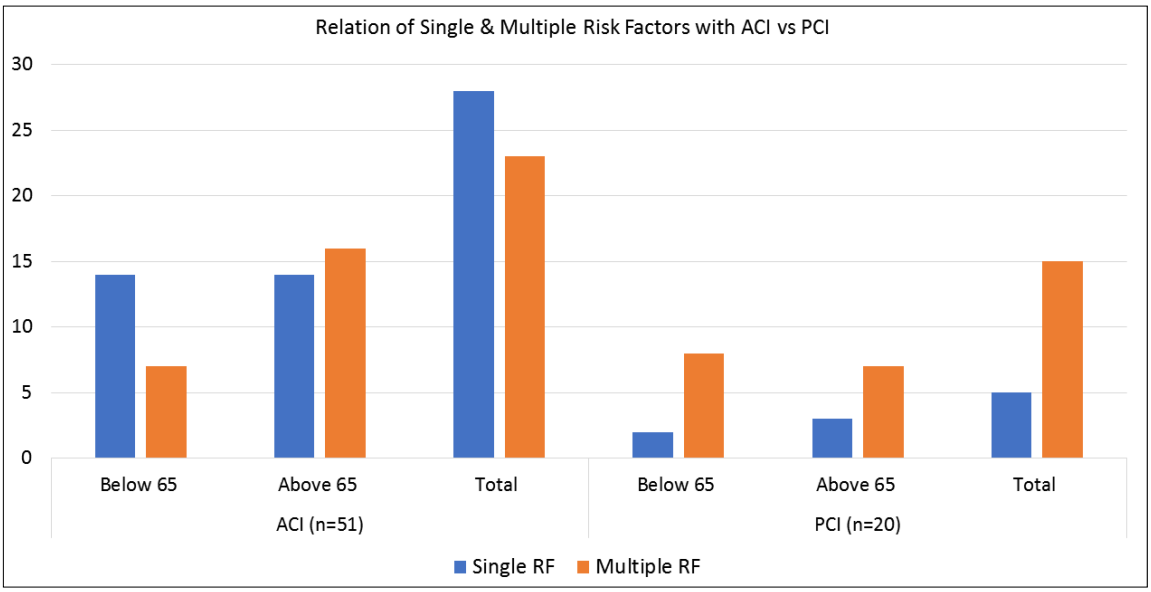

Fig 3: The relation of single and multiple risk factors in patients with anterior circulation versus posterior circulations infarction

Discussion

Stroke is a heterogenous syndrome and the leading cause of long-term adult disability and death in several countries. While it can be determined by risk factors and treatment which depends on the pathogenesis of types of stroke [12]. According to the prevalence of stroke, in the developing countries, it has a vast public health burden which may rise in future because of demographic conversions of population [5]. As this stroke comes in a many different patterns it has been complicated to identify it based on their risk factors. Basically, it is divided into hemorrhagic and ischemic, and the severity depends on the site and extent of the brain damage as well as overall patient's health status. Due to change in western style diet is also one of the causes to increase the proportion of ischemic strokes than hemorrhagic [12].

Cerebrovascular diseases with ischemia in different parts of the brain can cause neurological deficits which found out that posterior circulation strokes are mostly ischemic and accounts 20% of all stroke with high mortality [5]. It may be because it consists of that vascular region where two arteries unite to form an arterial trunk which contain short branches that supply the major part of the brain like brain stem, thalamus etc [8].

There are various risk factors listed and categorized as modifiable and non-modifiable. But studies on these risk factors have not described the differentiation between types of hemorrhages and considered pathological and etiological separately [14]. All these risk factors associated with both hemorrhagic and ischemic stroke is more or less similar but notable differences were observed among their etiology of ischemic stroke. Along with the risk factors they may also cause the short-term risks or triggers infection, inflammatory and long-term diseases [12]. Thus, there is a need to reduce the burden of stroke among the population which requires to identify the modifiable risk factors and description of their efficacy for reduction [1]. But modifiable risk factors can be identified and prevented like they are hypertension, diabetes mellitus, cardiovascular diseases, high blood cholesterol, smoking, and alcohol consumption. Other than common risk factors some biochemical factors and circulating molecules were also studied as risk factors for vascular diseases and it was observed that low levels of vitamin D3 and high level of uric acid can lead to ischemic stroke [17]. Some studies also revealed that prevalence of hypertension and smoking can be a major risk factor in patients with PC strokes, while hyperlipidemia was risk factor for both ACI and PCI [14].

In comparison, non-modifiable risk factors are very few which includes age and gender. In this study we have considered these two factors, and the association of ACI and PCI with the risk factors involved in it. Few studies were carried out by taking consideration of non-modifiable factors while, modifiable factors were studied the most. Risk factor identification was carried out on the basis of reliability of case histories on memory dependent patients are limited [18]. Common risk factors like hypertension, heart diseases, were observed common in stroke patients. Prospective study was carried out to quantify the risks of these conditions in various communities [4].

Current study demonstrates that among the 71 patients studied maximum patients were observed which are diagnosed with the ACI than PCI. Differential diagnoses of types of stroke, by age and sex, are shown in Table 1. While the prevalence for stroke with ACI and PCI was found more in female above 65 years of age and that of patients below 65 years of age male patients predominated. It was observed that some traditional vascular risk factors for ischemic stroke appears to exert different magnitudes of risks for PCI compared to ACI ischemic stroke [11].

We must consider the single and multiple risk factors involved in ACI and PCI for the patients above and below 65 years of age. As age can be considered as a marker for duration of the exposure to other risk factors of stroke. Thus, this can be the strongest determinant of survival as well as the risk associated with the stroke as it doubles every decade above age 55 [10]. Some studies have been reported that average annual case fatality rates for survivors from long term strokes were around 10% for 65-74 years and 20% for 75 years and more [1]. Thus, age can be important non modifiable risk factor for the study as earlier study also mentioned that people, those aged 65 years and over mostly which are unable to care themselves before their strokes occurred are the major victims of ischemic strokes [4].

In our study, generally there was no great differences between men and women in the various types of stroke were

observed. Present study also states relation of single versus multiple risk factors between anterior and posterior circulations stroke below and above 65 years old group where we have observed statistically significant relation between ACI and PCI for both the groups. This part of our study is crucial because age strongly influenced the speed of recovery. Earlier studies showed that subarachnoid hemorrhage was frequently diagnosed in the patients under the age of 65 in many states (almost 20%) while some countries are affected only 10-15% [1]. Similarly, intracerebral hemorrhage was found in some countries of patients aged under 65 years. As the incidence stroke in the form of ACI, PCI, cerebral embolism was increased with age, there has to be considerable parameter for taking patients above and below 65 year of age for the study. Our study is consistent with study done by Kim *et al*. [19], which states that prevalence of risk factors and mechanism of strokes differ between ACI and PCI. PCI is closely associated with the metabolic derangement and local branch occlusion. This difference has to be considered in prevention and management strategies. Another study also stated an alternative approach to prevention of stroke, as therapies like polypill and risk estimation in primary care after stroke triggers have potential to change the future of stroke prevention [12].

Conclusions

Strokes occurring in PC were associated with multiple risk factors more than those occurring in AC especially in patients below 65-year age, therefore their identification and control have important impacts on reduction of mortality of stroke. However, the impact of risk factors on AC and PC strokes and the prevalence were nearly equal in both sexes.

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