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Patient Demographics, Characteristics and Intrahospital Mortality of Different Ischemic Stroke Subtypes in a Tertiary Hospital During Five-Year Period †

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Abstract: *Background and Objectives.* Ischemic stroke (IS) is one of the leading causes of disability, morbidity, and mortality worldwide. The goal of this study was to evaluate patient demographics, characteristics and intrahospital mortality among patients with different IS subtypes. *Materials and Methods.* An observational non-randomized study was conducted using IS patient data from a single center from 2016 till 2020 with the diagnosis of acute IS confirmed by head computed tomography (CT). The pathogenetic IS subtypes were determined using Causative Classification System for IS (CCSIS). *Results.* There was a slight female predominance among our study population, as 2673 (56.2%) patients were females. In our study group, most common IS subtypes were cardioembolic stroke (CS), 2252 (47.4%), and atherothrombotic stroke (AS), 1304 (27.4%). CS patients were significantly more severely disabled on admission, 1828 (81.4%), and on discharge, 378 (16.8%), $p < 0.05$. Moreover, patients with CS demonstrated the highest rate of comorbidities and risk factors, this was also statistically significant, $p < 0.05$. Differences between the total patient count with no atrial fibrillation (AF), paroxysmal AF, permanent AF and different IS subtypes among our study population demonstrated not only statistical significance, but also a strong association, Cramer's V = 0.53. Majority of patients in our study group were treated conservatively, 3389 (71.3%). Reperfusion therapy was significantly more often performed among CS patients, 770 (34.2%), $p < 0.05$. The overall intrahospital mortality among our study population was 570 (12.0%) with the highest intrahospital mortality rate noted among CS patients, 378 (66.3%), $p < 0.05$. No statistically significant difference was observed between acute myocardial infarction and adiposity, $p > 0.05$. *Conclusions.* In our study, CS and AS were the most common IS subtypes. CS patients were significantly older with slight female predominance. CS patients demonstrated the greatest disability, risk factors, comorbidities, reperfusion therapy and intrahospital mortality.

Keywords: ischemic stroke; demographics; intrahospital mortality; cardioembolic stroke; atherothrombotic stroke; lacunar stroke; computed tomography; reperfusion therapy; conservative therapy

1. Introduction

Ischemic stroke (IS) is the fifth leading cause of adult disability, cognitive dysfunction and mortality with an immense economic burden worldwide, especially in the increasingly older population [1,2]. It is known that in the Unites States, 795,000 people every year develop stroke with 610,000 of them being first strokes [3].

Many risk factors for IS development have been reported encompassing nonmodifiable and modifiable conditions. Nonmodifiable risk factors include patient age, sex, race, ethnicity, family history of stroke or transient ischemic attacks (TIA) and history of migraine attacks [4,5], whereas diabetes mellitus, atrial fibrillation, heart failure, valvular disease, hypercholesterolemia, lifestyle issues as excessive alcohol intake, smoking, illicit drug use, sedentary lifestyle, obesity, oral contraceptive use are modifiable risk factors with the highest importance of arterial hypertension [6]. Nevertheless, IS is considered a preventable entity if the population modifiable risk factors can be addressed appropriately.

Studies among different populations have been performed suggesting regional variabilities concerning the distribution of IS types and prevalence their risk factors. Early mortality rate 30 days after IS has been estimated at around 15% [7]. The causes of death after IS may be influenced by numerous factors including not only patient risk factors but also access to health-care resources, medical treatment, economic support medical costs etc [8].

The main treatment for IS include active reperfusion therapy with the administration of intravenous tissue plasminogen activator. If the reperfusion therapy is contraindicated, the patient is administered conservative therapy only [9,10].

The goal of this study was to evaluate patient demographics, characteristics and intrahospital mortality among individuals admitted to the tertiary university hospital with the principal diagnosis of acute IS.

2. Materials and Methods

An observational non-randomized study was conducted using IS patient data from a single center in the time period between 2016 and 2020 with the diagnosis of acute IS confirmed by head computed tomography (CT) were included.

The pathogenetic IS subtypes were determined using Causative Classification System for IS (CCSIS) including atherothrombotic stroke (AS), cardioembolic stroke (CS), lacunar stroke (LS), other specified stroke (OSS) types and unspecified stroke (US). Data on patient demographics, comorbidities, stroke etiology, length of patient intrahospital stay and death were recorded. At patient admission, their neurological status was evaluated using the National Institute of Health Stroke Scale. Modified Rankin Scale (mRS) was also calculated during this time.

This study was approved by the Local Ethical Committee of Rīga Stradiņš University, Rīga, Latvia. Patient personal data were not included in the study.

All data were analyzed using Microsoft Excel and IBM Statistical Package of the Social Sciences (SPSS) 23.0. In statistical analysis, data were expressed as absolute numbers and percentage, median and interquartile range where appropriate. Independent samples t-test, one-way analysis of variance (ANOVA), post hoc tests, Kruskal-Wallis test, Tukey's test and Chi-Square tests were performed where appropriate. A p-value < 0.05 was considered statistically significant.

3. Results

3.1. Baseline Patient Demographic Data

In the time from 2016 till 2020, a total of 4753 patients were admitted to the tertiary university hospital with the diagnosis of acute IS.

Median patient age among our study population was 75 (interquartile range (IQR) = 66–82) years old with CS patients being older as their median age was 78 (IQR = 71–84) years old, while all other IS subtype patients were younger, as their median age was as

follows: among AS patients – 72 (IQR = 64–80) years old, LS patients: 70 (IQR = 60–79) years old, OSS–63 (IQR = 48–76) years old and US patients–71 (IQR = 60–80) years old, and this was statistically significant, $p < 0.05$ (see Table 1).

There was a slight female predominance among our study population, n = 2673 (56.2%). Among patients with CS, 1442 (64.0%) were females. The highest percentage of female patients were noted among CS patients, 1442 (64.0%), meanwhile among patients with AS there were 610 (46.8%) female patients. 212 (47.0%) LS patients were females, but in OSS and US patients, 58 (50.4%) and 351 (55.6%) were females, respectively. This difference was statistically significant, $p < 0.05$ (see Table 1).

Table 1. Median patient age and female distribution among our study population.

	CS	AS	LS	OSS	USS	*p*–value
Median patient age, IQR	78 (IQR = 71–84)	72 (IQR = 64–80)	70 (IQR = 60–79)	63 (IQR = 48–76)	71 (IQR = 60–80)	<0.05
Gender, F - females	F: 1442 (64.0%)	F: 610 (46.8%)	F: 212 (47.0%)	F: 58 (50.4%)	F: 351 (55.6%)	<0.05

3.2. Patient Evaluation Data on Their Admission and Their Intrahospital Stay

On admission, all patient level of consciousness was evaluated using GCS. Among all patients, median GCS was 15 (IQR 13–15). Median GCS in CS patients was lower than the median GCS among all patients as it was 14 (IQR = 11–15), while median GCS among other IS subtypes was the same as median GCS among all patients in our study group, 15, with variable IQRs: IQR=14-15 in AS and in OSS, IQR = 15–15 in LS and IQR = 13–15 in US patients, and this difference was statistically significant, $p < 0.05$ (see Table 2).

Moreover, on admission, all patient impairment by stroke was objectively quantified using NIHSS. Median NIHSS score among all patients in our study group was 7 [IQR = 4–14]. In patients with CS, median admission NIHSS score was higher as it was 10 [IQR = 5–16], but in all other IS subtypes the median NIHSS score on admission was lower than the median NIHSS score among all patients in our study group as their median NIHSS score were as follows: 6 (IQR = 3–10) in AS and OSS patients, 6 (IQR = 3–12) in US patients and 4 (IQR = 2–5) in LS patients. This was statistically significant, $p < 0.05$ (see table 2).

All patients were evaluated on admission not only using GCS and NIHSS score, but the degree of disability and/or dependance in daily activities was evaluated using modified Rankin Score (mRS). Patient functional status on admission using mRS was defined as "slight disability" (0–2), "moderate disability" (3) and "severe disability" (4–5). In our study group, 720 (15.2%) patients presented with slight disability, while 647 (13.6%) patients had moderate disability on admission, but majority of patients, 3377 (71.2%) patients, were severely disabled.

- Among patients with slight disability at the admission, 197 (8.8%) were CS patients, that being statistically significantly less to compare with all patients who presented with slight disability in our study population: 219 (16.8%) in AS patients, 165 (36.7%) in LS patients, this being statistically significantly more often than in all patients with slight disability on admission, 23 (20.0%) in OSS patients and 116 (18.4%) in US patients, respectively, $p < 0.05$.
- Moreover, 220 (9.8%) CS patients presented with moderate disability, and this was also noted significantly less than among all patients who presented with moderate disability. 213 (16.3%) patients with AS and 103 (22.9%) patients with LS presented with moderate disability significantly more often to compare with all patients with moderate disability on admission. In our study group, 15 (13.0%) OSS patients and 96 (15.2%) US patients had moderate disability on admission, $p < 0.05$.
- Majority of patients presented with severe disability. Statistically significantly the highest prevalence of severely disabled patients on admission in

our study group was found in CS patients as 1828 (81.4%) of them were severely disabled. Patients with LS and AS were significantly less severely disabled on admission to compare with all severely disabled patients on admission in our study group: 182 (40.4%) in LS patients, 871 (66.8%) in AS patients, respectively. 77 (67.0%) OSS patients and 419 (66.4%) US patients were severely disabled on admission. These differences were statistically significant, $p < 0.05$. Nevertheless, the association between patient degree of disability at the time of patient admission at the hospital and different IS subtypes was weak, Cramer's V = 0.2 (see Table 2).

In our study, we also included patients without history of cerebrovascular events, patients with transient ischemic attack (TIA) and patients with anamnesis of previous stroke. 3514 (73.9%) patients demonstrated no history of cerebrovascular events; therefore, these were cases of first-ever stroke episodes. 25 (0.5%) were patients with TIA, but 1214 (25.5%) patients had an anamnesis of previous stroke, therefore these were cases of recurrent stroke (see Table 2).

- Among CS patients, 1633 (72.5%) were cases of patients with first-ever stroke episode. On the other hand, in AS patients, 960 (73.6%) were cases of patients with first-ever stroke episode. In 333 (73.8%) LS patients, this was the first-ever stroke episode. 93 (80.9%) patients with OSS and 495 (78.4%) US patients presented as the first-ever stroke episode, $p < 0.05$.
- In our study, 7 (0.3%) patients with CS were cases of TIA, but in AS patients – 12 (0.9%) patients had TIA. Among LS patients, TIA was observed in 4 (0.9%) patients, but, on the contrary, there were no patients with TIA among OSS patients. 2 (0.3%) US patients had TIA, $p < 0.05$.
- In CS patients, 612 (27.2%) patients had a recurrent stroke, and in AS patients there were 332 (25.5%) cases of recurrent stroke. Among patients with LS, 114 (25.3%) were cases of recurrent stroke. 22 (19.1%) patients with OSS had a recurrent stroke, but in patients with US, 134 (21.2%) were cases of recurrent stroke. These differences between the total amount of patients with first-ever stroke episode, TIA, recurrent stroke and different IS subtypes were statistically significant, $p < 0.05$, but this association, however, was weak, Cramer's V = 0.05 (see Table 2).

Table 2. Patient evaluation data on admission and their history of cerebrovascular events.

	CS	AS	LS	OSS	USS	*p*–value
Admission GCS	14 (IQR = 11–15)	15 (IQR = 14–15)	15 (IQR = 15–15)	15 (IQR = 14–15)	15 (IQR = 13–15)	<0.05
NIHSS on admission	10 (IQR = 5–16]	6 (IQR = 3–10]	4 (IQR = 2–5]	6 (IQR = 3–10)	6 (IQR = 3–12)	<0.05
mRS on admission:						
1. Slight disability (0-2)	1. 197 (8.8%)	1. 219 (16.8%)	1. 165 (36.7%)	1. 23 (20.0%)	1. 116 (18.4%)	<0.05
2. Moderate disability (3)	2. 220 (9.8%)	2. 213 (16.3%)	2. 103 (22.9%)	2. 15 (13.0%)	2. 96 (15.2%)	
3. Severe disability (4-5)	3. (1828 (81.4%)	3. 871 (66.8%)	3. 182 (40.4%)	3. 77 (67.0%)	3. 419 (66.4%)	
Cerebrovascular events						
1. First-ever stroke episode	1. 1633 (72.5%)	1. 960 (73.6%)	1. 333 (73.8%)	1. 93 (80.9%)	1. 495 (78.4%)	<0.05
2. Transient ischemic attack	2. 7 (0.3%)	2. 12 (0.9%)	2. 4 (0.9%)	2. 0 (0.0%)	2. 2 (0.3%)	
3. Recurrent stroke	3. 612 (27.2%)	3. 332 (25.5%)	3. 114 (25.3%)	3. 22 (19.1%)	3. 134 (21.2%)	

3.3. Patient Intrahospital Stay and Their Evaluation Data on Discharge

Median patient intrahospital stay among our study population was 10 (IQR = 7–14) days. Median intrahospital stay among CS, AS and OSS patients was similar to the median patient intrahospital stay in our study group as it was 10 days (IQR = 7–15 in CS patients, IQR = 7–13 in AS patients, IQR = 7–14 in OSS patients, respectively). The shortest median intrahospital stay was found in LS patients, 8 (IQR = 6–10) days. Median intrahospital stay in US patients was 9 (IQR = 6–13) days. These differences were statistically significant, $p < 0.05$ (see Table 3).

All patients were repeatedly evaluated using NIHSS score before discharge from the hospital. Median NIHSS score at the time of patient discharge from the hospital in our study group was 3 (IQR = 1–7). In patients with CS, median NIHSS score at the time of patient discharge was higher as it was 4 (IQR = 2–10), but in patients with AS, OSS and US it was similar to the median NIHSS score: 3 (IQR = 2–6 in AS patients, IQR = 1–6 in OSS patients and IQR = 1–6 in US patients, respectively). The lowest median NIHSS score at the time of patient discharge from the hospital was among LS patients, 2 (IQR = 1–3), and these differences were statistically significant, $p < 0.05$ (see Table 3).

All patient degree of disability and/or dependance in daily activities was repeatedly evaluated before they were discharged from the hospital mRS. Among our study population, 1763 (37.1%) patients reached satisfactory outcome. On the other hand, there were 793 (16.7%) patients with moderate disability, but severe disability was present in 1627 (34.2%) patients. Unfortunately, 570 (12.0%) patients died in our study population.

- 655 (29.1%) CS patients reached satisfactory outcome, that being significantly less to compare with all patients in our study who reached satisfactory outcome. On the contrary, 295 (65.4%) LS patients reached satisfactory outcome, that being significantly more often to compare with all patients who reached satisfactory outcome. In our study, satisfactory outcome was noted in 495 (38.0%) AS patients, 49 (42.6%) OSS patients and in 269 (42.6%) US patients, $p<0.05$.
- Moderate disability at the time of patient discharge was noted in 337 (15.0%) CS patients, while in AS patients 255 (19.6%) reached moderate disability. It was also noted in 85 (18.8%) LS patients. Moderate disability was also seen in 22 (19.1%) OSS patients and in 94 (14.9%) US patients, $p < 0.05$.
- CS patients statistically significantly more often reached level of severe disability, but patients with LS – statistically significantly less frequently as 882 (39.2%) CS patients and 68 (15.1%) LS patients were severely disabled at the time of patient discharge from the hospital. 455 (34.9%) AS patients, 34 (29.6%) and 188 (29.8%) US patients were severely disabled at the time of patient discharge from the hospital, $p < 0.05$.

Among patients who died, there were significantly more CS patients, 378 (16.8%), while those with LS died significantly less often as 3 (0.7%) of them died. 99 (7.6%) AS patients died, but, among OSS patients, 10 (8.7%) patients died, and 80 (12.7%) were US patients. These differences were statistically significant, $p < 0.05$. Nevertheless, the association between total patient count who reached satisfactory outcome and different IS subtypes was weak, Cramer's V = 0.2 (see Table 3).

Table 3. Patient intrahospital stay and their evaluation data on discharge.

	CS	AS	LS	OSS	USS	*p*–value
Intrahospital stay, days	10 (IQR = 7–15)	10 (IQR = 7–13)	8 (IQR = 6–10)	10 (IQR = 7–14)	9 (IQR = 6–13)	<0.05
NIHSS on discharge	4 (IQR = 2–10)	3 (IQR = 2–6)	2 (IQR = 1–3)	3 (IQR = 1–6)	3 (IQR = 1–6)	<0.05
mRS on discharge:	1. 655 (29.1%)	1. 495 (38.0%)	1. 295 (65.4%)	1. 49 (42.6%)	1. 269 (42.6%)	<0.05

1. Satisfactory outcome (0-2)	2. 337 (15.0%)	2. 255 (19.6%)	2. 85 (18.8%)	2. 22 (19.1%)	2. 94 (14.9%)
2. Moderate disability (3)	3. 882 (39.2%)	3. 455 (34.9%)	3. 68 (15.1%)	3. 34 (29.6%)	3. 188 (29.8%)
3. Severe disability (4-5)	4. 378 (16.8%)	4. 99 (7.6%)	4. 3 (0.7%)	4. 10 (8.7%)	4. 80 (12.7%)
4. Dead (6)					

3.4. Patient Treatment and Their Intrahospital Mortality

In our study population, 1364 (28.7%) patients received reperfusion therapy (RT), and majority of them were CS patients, 770 (34.2%). Among AS patients, 318 (24.4%) received RT. RT was less often performed among LS patients, as only 59 (13.1%) LS patients received RT, while there were 23 (20.0%) OSS patients who received RT, but among US patients 194 (30.7%) received RT. This was statistically significant, $p < 0.05$ (see Table 4).

Majority of patients did not receive reperfusion therapy: 3389 (71.3%), therefore, these patients were treated conservatively.

- In patients who received RT, the most common RT performed was intravenous thrombolysis (IVT) as it was observed in 860 (18.1%) patients, but mechanical thrombectomy (MTE) demonstrated the lowest prevalence as it was performed in 155 (3.3%) patients. 349 (7.3%) patients received both, IVT and MTE.
- Majority of patients in all IS subtypes received conservative treatment, and the distribution of these patients was as follows: 1482 (65.8%) CS patients, 986 (75.6%) AS patients, 392 (86.9%) LS patients, 92 (80.0%) OSS patients and 437 (69.3%) US patients were treated conservatively, $p < 0.05$.
- In our study group, IVT was performed in 440 (19.5%) CS patients and in 219 (16.8%) AS patients. 57 (12.6%) LS patients also received IVT, as well as 11 (9.6%) OSS patients, but among US patients, IVT was performed in 133 (21.1%) patients, $p < 0.05$.
- Moreover, 97 (4.3%) CS patients received MTE only, while among AS patients, 38 (2.9%) were treated with MTE. 2 (0.4%) LS patients received MTE, but among OSS patients, 4 (3.5%) received MTE, and in US patients – 14 (2.2%) received MTE, $p < 0.05$.
- IVT + MTE was performed in 233 (10.3%) CS patients, but among AS patients – in 61 (4.7%) patients. On the contrary, no LS patients were treated with IVT + MTE. In our study, 8 (7.0%) OSS patients and 47 (7.4%) US patients received both, IVT + MTE. These differences were statistically significant, $p<0.05$. Nevertheless, the association between total patient count who were treated conservatively, received different RT and distinct IS subtypes, was weak, Cramer's V = 0.10 (see Table 4).

The overall intrahospital mortality among our study population was 570 (12.0%). The highest intrahospital mortality rate was detected among CS patients, as 378 (66.3%) CS patients died, but the lowest rate was noted among LS patients – 3 (0.5%), respectively. 99 (17.4%) patients with AS died, but among those with OSS, 10 (1.8%) patients died. 80 (14.0%) US patients died. These differences between the overall patient count who died during their intrahospital stay and different IS subtypes were statistically significant, $p < 0.05$. Nevertheless, this association was weak, Cramer's V = 0.2 (see Table 4).

Table 4. Patient treatment and their intrahospital mortality.

	CS	**AS**	**LS**	**OSS**	**USS**	***p*-value**
Reperfusion therapy (RT)	770 (34.2%)	318 (24.4%)	59 (13.1%)	23 (20.0%)	194 (30.7%)	<0.05

Received therapy: **1. Conservative therapy** **2. IVT** **3. MTE** **4. IVT + MTE**	1. 1482 (65.8%) 2. 440 (19.5%) 3. 97 (4.3%) 4. 233 (10.3%)	1. 986 (75.6%) 2. 219 (16.8%) 3. 38 (2.9%) 4. 61 (4.7%)	1. 392 (86.9%) 2. 57 (12.6%) 3. 2 (0.4%) 4. 0 (0.0%)	1. 92 (80.0%) 2. 11 (9.6%) 3. 4 (3.5%) 4. 8 (7.0%)	1. 437 (69.3%) 2. 133 (21.1%) 3. 14 (2.2%) 4. 47 (7.4%)	<0.05
Intrahospital mortality	378 (66.3%)	99 (17.4%)	3 (0.5%)	10 (1.8%)	80 (14.0%)	<0.05

3.5. Patient Comorbidities and Risk Factors

In total, AH was found in 3972 (83.6%) patients in our study group. AH was detected in 1893 (84.1%) CS patients and in 1115 (85.5%) AS patients, but among LS patients, 393 (87.1%) patients had AH. 75 (65.2%) OSS patients and 496 (78.6%) US patients also had AH, and these differences between the total AH patient count and different IS subtypes were statistically significant, $p < 0.05$. However, this association was weak, Cramer's V = 0.10 (see Table 5).

In our study, we included patients with no history AF, paroxysmal AF and permanent AF. 2616 (55.0%) patients demonstrated no history of AF, paroxysmal AF was found in 636 (13.4%) patients, but permanent AF was noted in 1501 (31.6%) patients among our study population (see Table 5).

- 356 (15.8%) CS patients had no history of AF, but, among patients with AS, 1231 (94.4%) patients had no history of AF. 376 (83.4%) LS patients demonstrated no history of AF, but among patients with OSS and US, no history of AF was found in 107 (93.0%) OSS patients and in 546 (86.5%) US patients, $p < 0.05$.
- On the other hand, paroxysmal AF was present in 539 (23.9%) CS patients, but only 35 (2.7%) AS patients had paroxysmal AF. In our study, 26 (5.8%) LS patients had paroxysmal AF, and it was also present in 4 (3.5%) OSS patients and in 32 (5.1%) US patients, $p < 0.05$.
- Permanent AF was present in 1357 (60.3%) CS patients, while among other IS subtypes, the prevalence of permanent AF was much less common, as it was found in 38 (2.9%) AS patients, but among LS patients it was present in 49 (10.9%) patients. Permanent AF was also observed in 4 (3.5%) OSS patients and in 53 (8.4%) US patients. These differences between the total patient count with no AF, paroxysmal AF, permanent AF and different IS subtypes among our study population were statistically significant, $p < 0.05$. Moreover, this association was strong, Cramer's V = 0.53 (see Table 5).

CHD was found in 895 (18.8%) patients in our study group. CHD was detected in 522 (23.2%) CS patients, but among AS patients, 220 (16.9%) had CHD. Among LS patients, CHD was observed in 57 (12.6%) patients, but 9 (7.8%) OSS patients and 87 (13.8%) US patients also had CHD. These differences were statistically significant to the total CHD patient count, p<0.05. Unfortunately, the association between the overall CHD patient count and different IS subtypes among our study population was weak, Cramer's V = 0.11 (see Table 5).

In total, 300 (6.3%) patients in our study group had AP. Among CS patients, AP was found in 169 (7.5%) patients, and in patients with AS – in 76 (5.8%) patients. AP was also noted in 20 (4.4%) LS patients, in 1 (0.9%) OSS patient and it was also present in 34 (5.4%) US patients. These differences were statistically significant to the total AP patient count, $p < 0.05$. Nevertheless, the association between the overall AP patient count and distinct IS subtypes among our study group was weak, Cramer's V = 0.06 (see Table 5).

In general, AMI was observed in 48 (1.0%) patients among our study group. AMI was found in 27 (1.2%) CS patients, but in AS patients – 9 (0.7%) patients had AMI. Among

patients with LS, AMI was noted in 2 (0.4%) patients, and 2 (1.7%) OSS patients also had AMI, but in US patients, AMI was present in 8 (1.3%) patients. This difference was not statistically significant, $p = 0.33$ (see Table 5).

Among our study population, 1879 (39.5%) patients demonstrated a history of CHF. 1224 (54.4%) CS patients had a history of CHF, but, in AS patients, CHF was present in 355 (27.2%) patients. Among patients with LS, CHF was found in 92 (20.4%) patients, but in patients with OSS, 22 (19.1%) patients had CHF, and in patients with US, CHF was observed in 186 (29.5%) patients. This difference was statistically significant to compare with the total CHF patient count, $p < 0.05$. However, the association between total CHF patient count and different IS subtypes was weak, Cramer's V = 0.29 (see Table 5).

In general, CKF was noted in 242 (5.1%) patients. CKF was present in 149 (6.6%) CS patients and in 46 (3.5%) AS patients. Among LS patients, 22 (4.9%) had a history of CKF. CKF was also detected in 4 (3.5%) OSS patients and in 21 (3.3%) US patients. This difference between the total CKF patient count and different IS subtypes was statistically significant, $p < 0.05$, but, unfortunately, this association was weak, Cramer's V = 0.07 (see Table 5).

In our study, we included patients without abnormalities in BTBV, patients with anamnesis of endarterectomy and/or stenting operations, stenosis of 50% in BTBV and at least 70% stenosis in these blood vessels.

- Majority of patients demonstrated no abnormalities in BTBV: 3856 (81.1%). On the other hand, 16 (0.3%) patients had an anamnesis of endarterectomy and/or stenting operations, 30 (0.6%) patients demonstrated stenosis of 50% in BTBV, but 851 (17.9%) patients had stenosis of at least 70% in these blood vessels.
- In our study, 1997 (88.7%) CS patients had normal BTBV, but only 807 (61.9%) AS patients had no abnormalities in BTBV. Normal BTBV were also detected in 390 (86.5%) LS patients, in 104 (90.4%) OSS patients and in 558 (88.4%) US patients, $p < 0.05$.
- Endarterectomy and/or stenting operations were noted among a very few patients among our study population. There were 6 (0.3%) CS patients with anamnesis of endarterectomy and/or stenting operations, and in AS patients – 6 (0.5%) patients. 1 (0.2%) LS patient and 1 (0.9%) OSS patient had anamnesis of endarterectomy and/or stenting operations, but among US patients, 2 (0.3%) patients had anamnesis of endarterectomy and/or stenting operations, $p < 0.05$.
- Furthermore, 50% stenosis in BTBV was present in 18 (0.8%) CS patients, but among AS patients – in 5 (0.4%) patients. In patients with LS, 5 (1.1%) had 50% stenosis in BTBV. On the contrary, there were no patients among OSS patients with 50% stenosis in BTBV, but 50% stenosis in BTBV was present in 2 (0.3%) US patients, $p < 0.05$.
- In our study, 231 (10.3%) CS patients had >70% stenosis in BTBV, and among AS patients >70% stenosis in BTBV was present in 486 (37.3%) patients, respectively. 55 (12.2%) LS patients demonstrated >70% stenosis in BTBV. Among OSS patients, 10 (8.7%) patients had >70% stenosis in BTBV, and in US patients this stenosis was noted in 69 (10.9%) patients.
- These differences between the total patient count who had normal BTBV, anamnesis of endarterectomy and/or stenting operations, 50% stenosis and >70% stenosis in BTBV, and distinct IS subtypes were statistically significant, $p < 0.05$. However, this association demonstrated a weak association, Cramer's V = 0.18 (see Table 5).

In total, 240 (5.0%) patients in our study population were smokers. Smoking was detected in 43 (1.9%) CS patients, but, in patients with AS, 118 (9.0%) were smokers. 24 (5.3%) patients with LS were smokers. Smoking was detected in 3 (2.6%) OSS patients and in 52 (8.2%) US patients, respectively, and this difference between the overall smoker count and

different IS subtypes demonstrated a statistical significance, $p < 0.05$. Unfortunately, this association among our study group was weak, Cramer's V = 0.2 (see Table 5).

In our study population, history of alcohol abuse was found in 78 (1.6%) patients. Alcohol abuse was detected in 20 (0.9%) CS patients and in 32 (2.5%) AS patients, but among LS patients, 5 (1.1%) had a history of alcohol abuse. Alcohol abuse was also present in 4 (3.5%) OSS patients and 17 (2.7%) US patients, and these differences were statistically significant to the total count of patients who were smokers, $p < 0.05$. However, this association was weak, Cramer's V = 0.07 (see Table 5).

Dyslipidemia was found in 1873 (39.4%) patients among our study population. Dyslipidemia was present in 769 (34.1%) CS patients, but in AS patients it was noted in 626 (48.0%) patients. 215 (47.7%) LS patients had dyslipidemia, but among OSS patients, dyslipidemia was present in 39 (33.9%) 224 (35.5%) patients with US had dyslipidemia. These differences between the total count of patients with dyslipidemia and distinct IS subtypes were statistically significant, $p < 0.05$. Nevertheless, this association among our study population was weak, Cramer's V = 0.13 (see Table 5).

In general, adiposity was present in 306 (6.4%) patients in our study group. Among patients with CS, adiposity was detected in 141 (6.3%) patients, but, in AS patients, adiposity was seen in 86 (6.6%) patients. Adiposity was detected in 35 (7.8%) LS patients, but in OSS patients, 8 (7.0%) patients were adipose, and 36 (5.7%) US patients were adipose. There was no statistically significant difference observed between the total patient count with adiposity and different IS subtypes among our study population, $p = 0.72$ (see Table 5).

In our study group, diabetes mellitus (DM) was noted in 408 (8.6%) patients. 186 (8.3%) CS patients had DM, but in AS patients, DM was detected in 138 (10.6%) patients. DM was present in 41 (9.1%) LS patients and in 5 (4.3%) OSS patients. 38 (6.0%) US patients had DM, and these differences between the total DM patient count and different IS subtypes were statistically significant, $p < 0.05$. However, this association was weak, Cramer's V = 0.10 (see Table 5).

In total, history of oncology was observed in 258 (5.4%) patients. Oncology was present in 127 (5.6%) CS patients and 57 (4.4%) AS patients also had a history of oncology. Among LS patients, oncology was detected in 21 (4.7%) patients, and in OSS patients – 23 (20.0%) patients had oncology. 30 (4.8%) US patients had oncology, and these differences between the total patient count with oncology and distinct IS subtypes were statistically significant, $p < 0.05$. Nevertheless, this association was weak, Cramer's V = 0.06 (see Table 5).

Table 5. Patient comorbidities and risk factors.

	CS	AS	LS	OSS	USS	*p*–value
Arterial hypertension	1893 (84.1%)	1115 (85.5%)	393 (87.1%)	75 (65.2%)	496 (78.6%)	<0.05
Atrial fibrillation (AF):						
1. No AF	1. 356 (15.8%)	1. 1231 (94.4%)	1. 376 (83.4%)	1. 107 (93.0%)	1. 546 (86.5%)	<0.05
2. Paroxysmal AF	2. 539 (23.9%)	2. 35 (2.7%)	2. 26 (5.8%)	2. 4 (3.5%)	2. 32 (5.1%)	
3. Permanent AF	3. 1357 (60.3%)	3. 38 (2.9%)	3. 49 (10.9%)	3. 4 (3.5%)	3. 53 (8.4%)	
Coronary heart disease	522 (23.2%)	220 (16.9%)	57 (12.6%)	9 (7.8%)	87 (13.8%)	<0.05
Angina pectoris	169 (7.5%)	76 (5.8%)	20 (4.4%)	1 (0.9%)	34 (5.4%)	<0.05

Acute myocardial infarction	27 (1.2%)	9 (0.7%)	2 (0.4%)	2 (1.7%)	8 (1.3%)	= 0.33
Chronic heart failure	1224 (54.4%)	355 (27.2%)	92 (20.4%)	22 (19.1%)	186 (29.5%)	< 0.05
Chronic kidney failure	149 (6.6%)	46 (3.5%)	22 (4.9%)	4 (3.5%)	21 (3.3%)	< 0.05
BTBV						
1. Normal BTBV	1. 1997 (88.7%)	1. 807 (61.9%)	1. 390 (86.5%)	1. 104 (90.4%)	1. 558 (88.4%)	
2. Endarterectomy and/or stenting operations	2. 6 (0.3%)	2. 6 (0.5%)	2. 1 (0.2%)	2. 1 (0.9%)	2. 2 (0.3%)	< 0.05
3. 50% stenosis	3. 18 (0.8%)	3. 5 (0.4%)	3. 5 (1.1%)	3. 0 (0.0%)	3. 2 (0.3%)	
4. >70% stenosis	4. 231 (10.3%)	4. 486 (37.3%)	4. 55 (12.2%)	4. 10 (8.7%)	4. 69 (10.9%)	
Smoking	43 (1.9%)	118 (9.0%)	24 (5.3%)	3 (2.6%)	52 (8.2%)	< 0.05
Alcohol abuse	20 (0.9%)	32 (2.5%)	5 (1.1%)	4 (3.5%)	17 (2.7%)	< 0.05
Dyslipidemia	769 (34.1%)	626 (48.0%)	215 (47.7%)	39 (33.9%)	224 (35.5%)	< 0.05
Adiposity	141 (6.3%)	86 (6.6%)	35 (7.8%)	8 (7.0%)	36 (5.7%)	= 0.72
Diabetes mellitus	186 (8.3%)	138 (10.6%)	41 (9.1%)	5 (4.3%)	38 (6.0%)	< 0.05
Oncology	127 (5.6%)	57 (4.4%)	21 (4.7%)	23 (20.0%)	30 (4.8%)	< 0.05

4. Discussion

This was an observational non-randomized study enrolling large number of mostly elderly patients admitted to a tertiary university hospital during five-year period, demonstrating CS as the most common IS subtype with the highest prevalence of severely disabled patients both, on admission, 1828 (81.4%), and on discharge, 882 (39.2%) patients, with the greatest intrahospital mortality, 378 (66.3%), despite having the highest reperfusion rate, 770 (34.2%) patients.

A prospective cohort study was performed in Switzerland in 2010 reporting CS as the most frequent IS subtype, as it was noted in 28.5% cases where 47.9% were female patients [11].

Moreover, a retrospective cross-sectional study in Indonesia was conducted in 2016 [12]. In their study, 59.1% patients were males demonstrating a slight male predominance. The most prevalent risk factor for IS where AH, as it was observed in 83.4% patients, followed by dyslipidemia, present in 50.6% patients, and diabetes mellitus, noted in 48.5% patients. In their study, AS was the most common IS subtype as it was seen in 59.6% patients [12]. In our study, the most prevalent IS subtype was CS, 2252 (47.4%), followed by AS, 1304 (27.4%), but the rarest IS subtype was OSS, 115 (2.4%) patients.

On the contrary, several studies on stroke patients have been performed in Japan revealing LS as the most common IS subtype [13]. Most common risk factors for LS among Japanese population included arterial hypertension (AH), ECG abnormalities, diabetes mellitus, obesity, and smoking [13]. Moreover, among LS patients, these risk factors were present more frequently to compare with CS and AS patients [13].

Among our study population, both, the prevalence of AH and adiposity, was the highest among LS patients, 393 (87.1%), and 35 (7.8%) patients, respectively. Interestingly, among smokers, the greatest prevalence was noted in AS patients as 118 (9.0%) of them were smokers, followed by US patients, 52 (8.2%) patients, respectively, but among LS patients – 24 (5.3%) patients were smokers.

Numerous studies suggest that there may be an independent association between LS and AH compared to other IS subtypes with similar clinical severity. Blood pressure

differences between different IS subtypes may not be related to the clinical severity of stroke but rather to the underlying cause of IS [14].

Atrial fibrillation (AF) is a very common cardiac arrhythmia with a significant cardiovascular morbidity and mortality. It is one of the leading preventable causes of IS for which early detection and treatment are critical [15]. Moreover, AF also contributes to higher morbidity and mortality when compared with non-AF related strokes. Strokes due to AF are very common and associated with very poor outcome, as 70–80% die or become disabled [15]. A study, performed on AF and IS in Canada, in 2013, revealed that among patients with acute IS, AF was present in 17.2% patients. Overall, in their study, patients with AF had significantly higher risk of death at 30 days (22.3% versus 10.2%), 12 months (37.1% versus 19.5%) and death or disability at discharge (69.7% versus 54.7%) [16].

To compare with our study, majority of patients in our study group did not have AF, as it was absent in 2616 (55.0%) patients. On the other hand, paroxysmal AF was present in 636 (13.4%) patients, but permanent AF was noted in 1501 (31.6%) patients, $p<0.05$. Both, paroxysmal and permanent AF was present mostly among CS patients, 539 (23.9%) and 1357 (60.3%) patients, respectively. These differences between the total patient count with no AF, paroxysmal AF, permanent AF and different IS subtypes among our study population were statistically significant, $p < 0.05$, and this was the only association that was strong in our study group, Cramer's V = 0.53.

Furthermore, several studies have been performed revealing stroke as a major public health issue with increasing incidence among younger patients [17]. However, the etiology of IS among these patients often remains unclear therefore further research on factors contributing to stroke at a younger age are warranted.

A study on stroke patient recanalization in Spain was performed and published in 2020. In their study, 19.6% AS patients received effective recanalization therapy while 31.1% patients received recanalization therapy that was not effective, while 22.8 patients did not receive recanalization therapy [18].

To compare with our study, 986 (75.6%) AS patients were treated conservatively. In our study, 219 (16.8%) AS patients received IVT, 38 (2.9%) received MTE, and in 61 (4.7%) patient both, IVT and MTE, were performed. In the study conducted in Spain, 34.8% CS patients were treated conservatively, but 45% CS patients received reperfusion therapy. To compare with our study, 1482 (65.8%) CS patients received conservative treatment, but 440 (19.5%) CS patients received IVT, 97 (4.3%) received MTE, and in 233 (10.3%) CS patients both, IVT + MTE were performed.

In other countries, patient intrahospital mortality for stroke patients has been reported to be at about 13% [19]. Moreover, a research study in China on causes of death for severe stroke patients was performed in 2018 revealing brain herniation, multiple organ failure, community acquired-lung infections, the use of mechanical ventilation, hypoproteinemia and a history of hypertension, as well as hospital-acquired pneumonia as the most important causes for death among stroke patients [8].

In our study, 570 (12.0%) patients died, that being relatively high intrahospital mortality rate. High mortality among our study population was associated with patient comorbidities, the high prevalence of severely disabled patients due to stroke and mistakes in the organization of national health care, as well as many other factors. The highest intrahospital mortality among our study population was noted among CS patients, 378 (66.3%), but the lowest intrahospital mortality rate was noted among LS patients, as only 3 (0.5%) LS patients died.

5. Conclusions

IS is one of the leading causes of disability, cognitive disfunction and mortality with a great public health importance, growing incidence among younger patients and an immense economic burden worldwide.

In our study population, IS was identified mostly about elderly patients with a slight female predominance. The two most common IS subtypes among our study population were CS and AS, but OSS was the rarest IS subtype.

Among our study group, CS patients demonstrated the highest rate of comorbidities and risk factors for IS, and this was statistically significant.

Differences between the total patient count with no atrial fibrillation (AF), paroxysmal AF, permanent AF and different IS subtypes among our study population demonstrated not only statistical significance, but also a strong association – this was the only comorbidity to display a strong association.

No statistically significant difference was observed between acute myocardial infarction and adiposity.

Majority of patients in our study group were treated conservatively, while among patients who received reperfusion therapy significantly more often than other patients, were CS patients.

Unfortunately, the greatest intrahospital mortality was also noted among CS patients, but, on the other hand, LS patients demonstrated the lowest intrahospital mortality rate.

Further research is warranted to assess factors contributing to higher mortality among IS patients.

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