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Cerebral Small Vessel Disease in Stroke Patients: A Single-Center Retrospective Study

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ABSTRACT

Background and Objectives: Cerebral Small Vessel Disease (CSVD) is a syndrome of clinical and imaging findings thought to arise from a disease affecting cerebral small vessels- perforating arterioles, capillaries, venules. CSVD causes abut a quarter of the acute ischemic stroke (AIS) and increases the risk of the large vessel stroke. It is also the most common cause of vascular dementia and causes cognitive impairment as well as depression.

MRI is the investigation of choice to detect and characterize CSVD. MRI biomarkers of CSVD includes- lacunes, white matter hyperintensities, microbleed, prominent Virchow-Robin spaces and acute subcortical infarction. Risk factors for SVD include hypertension, DM, dyslipidemia, smoking, ischemic heart disease, and alcohol consumption.

The objective of this research is primarily to study the Incidence/prevalence of small vessel disease (CSVD) on MRI in patients presents with AIS at SQUH. The secondary objectives were to analyze the risk factors for CSVD, to study different MRI biomarkers of the CSVD, and to analyze the outcome of stroke due to CSVD.

Methods: This is a retrospective observational single-centre study conducted at the Sultan Qaboos University Hospital, Muscat, Oman. The study population was patients presented to the SQUH emergency department with stroke between 2016-2018 (3 years). The study was conducted between April 2018– March 2019 (12 months). After applying the inclusion and exclusion criteria, the final study population was 206 patients. Each patient was evaluated for the presence and type of different MRI biomarkers of CSVD- lacunes, white matter hyperintensities, microbleed, prominent Virchow-Robin spaces and acute subcortical infarction. The findings were correlated with demographics and conventional stroke-related risk factors (HTN, DM, hyperlipidemia, ischemic heart disease). The outcome was evaluated by used of modified ranskin score.

Results: Of 206 patients, there were about 40.8% shows CSVD as a cause for the stroke (TOAST 3). In the remaining patients, the AIS was due to large vessels, cardioembolic and other causes (Non-TOAST 3). Hypertension was the most common risk factor contribute to CSVD with 70.4%, followed by diabetes with 65.9%, hyperlipidemia 32.1% and IHD 31.9 %,

Conclusion: Cerebral small vessels disease as a cause for AIS was seen in 40.8 % of the studied population at SQUH. Risk factors like HTN, DM, smoking, and atrial fibrillation are strongly associated with CSVD. Hypertension is the most prevalent and important risk factor for stroke in general. Lacunes and prominent perivascular spaces are the commonest MRI biomarkers of CSVD in our study population. No statistically significant difference in the outcome of stroke due to small vessel disease (TOAST-3) versus non-small vessel disease (non-TOAST 3).

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Background

Sporadic cerebral small vessel disease (SVD) is a group of pathologic processes that affect the small vessels of the brain. There are two main types of SVD- cerebral amyloid angiopathy and hypertensive arteriopathy. The clinical manifestations of SVD vary depending on the specific cause of the disease, as well as the brain regions affected. Individuals may present sudden onset stroke symptoms, progressive cognitive deterioration, dementia, gait disorder, sphincter dysfunctions, and psychiatric disorders.

It is a frequent finding on CT and MRI scans of older adults and is related to vascular risk factors.

Neuroimaging Biomarkers have been established as Surrogates for SVD and Best Visualized on MRI

1. Recent small subcortical infarcts
2. White matter hyperintensity
3. Lacunes of presumed vascular origin
4. Perivascular space
5. Cerebral microbleed
6. Brain atrophy not related to specific macroscopic focal injury
7. Cortical superficial siderosis
8. Cerebral cortical microinfarct (a new possible SVD biomarker)

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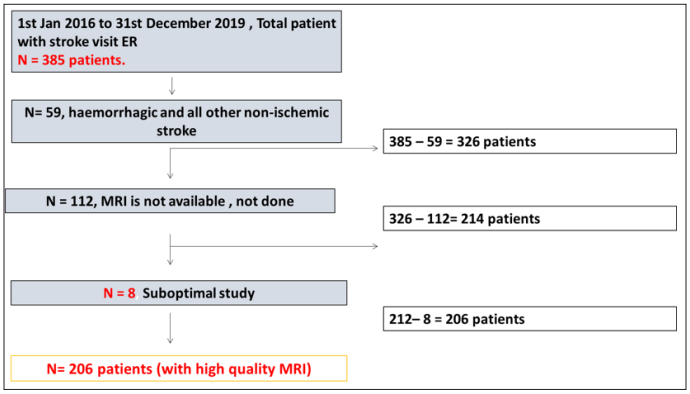
Objectives

To study the prevalence of cerebral small vessel disease (CSVD) on magnetic resonance imaging (MRI) in patients presents with acute ischemic stroke (AIS). In addition, we aimed to analyze the risk factors of CSVD, to study the different MRI biomarkers of the CSVD. This is study was continues to study the incidence of outcome of stroke due to CSVD.

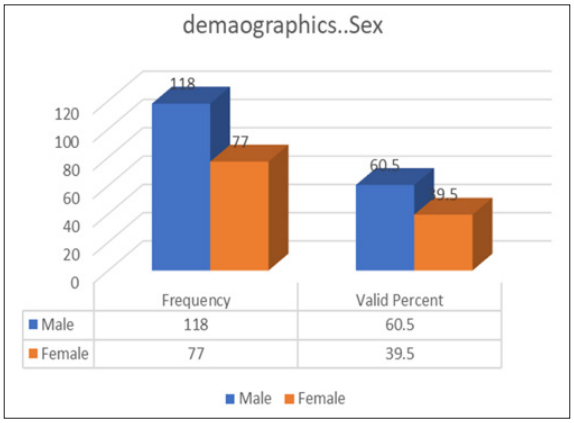
Methods

This is a retrospective observational single-center study conducted at Sultan Qaboos University Hospital (SQUH), Muscat, Oman between April 2018 and March 2019. The study population was patients with stroke presented to SQUH emergency department between 2016 and 2018 [1-3]. After applying the inclusion and exclusion criteria, the final study population were 211 patients. Each patient was evaluated for the presence and type of different MRI biomarkers of CSVD-lacunes, white matter hyperintensities, microbleed, prominent Virchow-Robin spaces, and acute subcortical infarction. The findings were correlated with demographics and conventional stroke-related risk factors such as hypertension (HTN), diabetes mellitus (DM), hyperlipidemia, and ischemic heart disease (IHD). This study was continued by used cohort study to follow up the patient during admission days to analyze the incidence of stroke outcome [4-5].

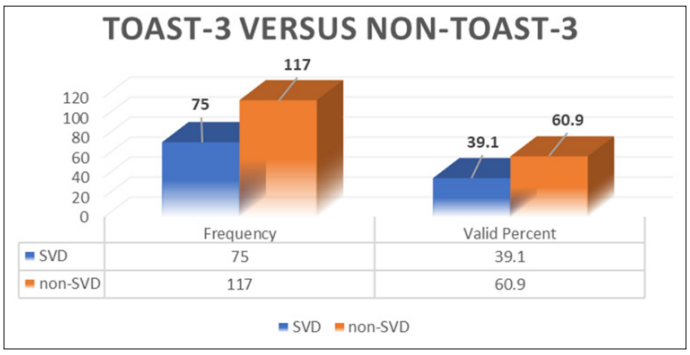
Enrolment chart:



Results: Demographics

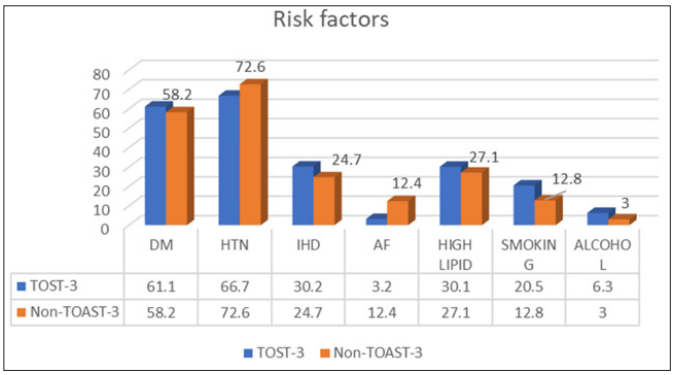


CSVD (TOAST-3) versus non-TOAST3



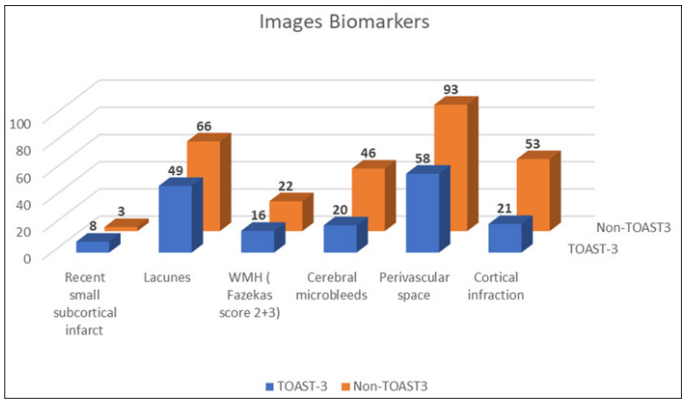
- Of 211 patients, 40.8% shows CSVD as a cause of stroke categorized as Trial of Org 10172 in Acute Stroke Treatment subtype no. 3 (TOAST 3). In the remaining patients, the AIS was due to large vessels, cardioembolic, and other causes (Non-TOAST 3). Among this category of Non-TOAST 3, at least 58.2% had associated CSVD.

Risk Factors



- Acquired risk factors (HTN, DM. smoking, atrial fibration), is strongly associated with present of neuroimages features of CSVD.
- Hypertension is the most prevalent and important risk factor for stroke in general [6].

Image's Biomarkers



	CSVD images biomarkers	TOAST-3	Non-TOAST3
2	Recent small subcortical infarct	8	3
3	Lacunes	49	66
4	WMH (Fazekas score 2+3)	16	22
5	Cerebral microbleeds	20	46
6	Perivascular space	58	93
7	Cortical infraction	21	53

- CSVD is the cause of AIS in approximately 40.8 % in our study population, which is compare to the west and Asian and gulf
- CSVD is a polyetiologic disease and the risk factors are similar to that of the large vessel disease including HTN, DM, dyslipidemia and smoking.
- Lacunes, WMH, dilated PVS, acute subcortical infarction and microbleeds were the biomarkers of the small vessel disease on MRI and were seen in both groups (TOAST-3 and non-TOAST-3) in a sizable number of patients.
- No statistically significant difference in the outcome of stroke due to small vessel disease (TOAST-3) versus non-small vessel disease (non-TOAST 3) [7].

Conclusions

CSVD as a cause for AIS was seen in 39.1% of the patients. Risk factors like HTN, DM, smoking, and atrial fibrillation are strongly associated with CSVD. Hypertension is the most prevalent and important risk factor for stroke in general. Lacunes and prominent perivascular spaces are the commonest MRI biomarkers of CSVD in our study population. There was no statistically significant difference in the outcome of stroke due to small vessel disease (TOAST-3) versus non-small vessel disease (non-TOAST-3) [8-11].

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