Research Article **AJBAS (2020) 3:16**

American Journal of Basic and Applied Sciences
(ISSN:2637-6857)

FACTORS ASSOCIATED WITH CEREBROVASCULAR ACCIDENT PATIENTS, AYDER COMPREHENSIVE SPECIALIZED HOSPITAL, MEKELLE, TIGRAY, ETHIOPIA

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ABSTRACT

Background: Cerebrovascular accident (CVA) is a problem that refers to a group of conditions that affect the circulation of blood to the brain. The objective of this study was to identify factors related to cerebrovascular accident patients in the Ayder Comprehensive Specialized Hospital. **Method**: A retrospective cohort study design was conducted in the Ayder Comprehensive Hospital from January 2015 to August 2016 and followed for a total of 20 days during the admission period. Data was collected from a database of electronic medical records and medical charts using a structured data extraction tool. Kaplan-Meier, log rank test and Cox-proportional hazard regression were used. STATA V.13 program was used for data entry, cleaning and analysis. **Result**: From 292 CVA case patients, 42(14.4%) died and (80.95%) were died with in the 7 days of hospital stay and their median survival time was also 7 days. Factors associated with CVA mortality were: positive history of hypertension (HR=4.8, 95%, CI= 1.486 - 16.018), positive history of diabetes mellitus (HR=2.0, 95%, CI= 1.086 - 3.789), Stroke sub type as haemorrhagic (HR= 2.1, 95%, CI= 1.070 - 4.160), admitted in intensive care unit (HR= 2.48, 95%, CI= 1.166 -5.306) and increased age (HR= 5.1, 95%, CI= 1.725 - 15.487) **Conclusion**: The risk rate of patients at an earlier time was high, and there was more death in the intensive care unit than any other medical wards. Hypertension was the most common risk factor for both types of cardiovascular accidents. Ischemic stroke subtype, diabetes mellitus and rising age were also associated survival factors.

Keywords: Stroke, Cerebrovascular accident, intensive care unit, associated factors

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How to cite this article:
Teshome Abegaz, Arega Gashaw. .FACTORS ASSOCIATED WITH CEREBROVASCULAR ACCIDENT PATIENTS, AYDER COMPREHENSIVE SPECIALIZED HOSPITAL, MEKELLE, TIGRAY, ETHIOPIA. American Journal of Basic and Applied Sciences, 2020, 3:16

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Website: https://escipub.com/

Introduction

Cerebrovascular incident is the medical term for a stroke that is a loss of brain function that needs immediate research and treatment. There are two main types of strokes that occur when blocking blood vessels are called ischemic and also called haemorrhagic for breakage. In both cases, the brain is deprived of blood and oxygen which causes the cells of the brain to die [1-3]. According to Lancet neurology magazine, the number of stroke deaths in low and middle income countries was 87%, the first among neurological cases [4, 5]. Approximately 85% of strokes are ischemic, usually thrombotic (when a clot develops in one of the arteries where fatty deposits provide blood to the brain), embolic (clot away from the brain typically in the heart). Hemorrhagic stroke (HS) may also be intracerebral (rapture or falling into the surrounding brain tissue), Subarachnoid (explosions or spills below the brain surface) [6-8]. Difficulty in speech and comprehension, numbness of the facial area and extremities, visual problems in both eyes and severe headache with vomiting are signs and symptoms of CVA. The patient may die or worsen conditions unless immediate intervention is performed as soon as possible [9, 10]. Depending on the length of shortage of blood flow and brain-affected sections, temporary or permanent problems such as paralysis, speaking difficulties, memory loss, and changing behavior pain can occur. A well-established rehabilitation center helps to better predict these problems and to reduce recovery time [11, 4]. Ischemic are 10 times more common than haemorrhagic from two forms of stroke, whereas haemorrhagic stroke mortality risk is lower. Related stroke factors could be categorized as uncontrollable factors, such as age and gender, and modifiable factors, such as obesity, diabetes and lifestyles (excisions, no cigarettes, less alcohol consumption)[2, 12]. [13-14]. Patients with stroke case received in a well-organized stroke unit has more likely to survive than those who received in a conventional ward. After the exposure of stroke, patients may need to stay long years or even lifelong in hospital in case of disability, long term medical management and lifetime treatment. So, in this case strengthening of rehabilitation center is important [15-17]. Conducting this type of study provides insight into the survival time and associated stroke factors in this health facility.

Materials and Methods

Study area and period

The study was conducted in Ayder Comprehensive Specialized Hospital (ACSH) located in Mekelle city, Tigray region which is 783 km from Addis Ababa (the capital city of Ethiopia). ACSH is a teaching referral hospital providing services for about 8 million people in the region and other neighbouring region (to Afar and south-eastern parts of the Amhara Regional State) and it provides a broad range of medical services 65,000-80,000 patients per year to both in and out patient of all age groups. It was established in 2007 G.C. and has 500 beds. The study was conducted from July to October 2016 using existed admitted patient data (January, 2015 to August, 2016) in ACSH from the EMR data base, HMIS registrations and physical archiving units of the hospital.

Study design

A retrospective cohort study design used for the quantitative methods in ACSH.

Study subject

The study subject was all cases with CVA who attended in ACSH during the selected admission period was included.

Source population

The source population was all cases with CVA patients who attended and managed in ACSH.

Eligibility criteria

Inclusion criteria

Patients who had CVA and admitted/discharged with full medical record was participated in this study. The last discharged condition and time during study period was considered as single event time.

Exclusion criteria

Patients who are not confirmed Cerebrovascular accident by CT or MRI and with incomplete medical records was excluded from this study.

Study variables

Dependent /Outcome variables:

- Survival time of CVA patient during hospital stay, the discharge conditions like improved, referred and refuse treatment was considered as censored

Independent variables:

- Age, Gender, Resident, hypertension status, Blood sugar level status, Stroke subtypes, Diagnosis Confirmed by, Ward name

Data collection procedure and management

Data collectors

Data extraction format was prepared for the data recording. Physicians were consulted for appropriate data extraction format. Two data collectors recruited and one final year internal medicine resident physician was consulted and trained on how to collect the required information from the EMR, HMIS and physical archiving units of the hospital. One-day training was given for them prior to data collection on how to abstract data, what specific and general information to be collected and how to contact the principal investigator and external consulting physician about the CVA by their respective system administrators.

Data collection instruments

Information about demographic characteristics (age, gender, and residence type), Biological status (Hypertension and diabetes), ward name (Medical ward or intensive care unit) date and time of admission and discharge was recorded on data extraction tool. Follow up admission/discharge registration and medical records was reviewed for all participant patients treated for CVA until the last discharged date from the ward or unit from January 2015 to August, 2016.

Data quality assurance

Training of data collectors was given to acquire basic skills necessary for data collection during the follow up periods. Every activity was strictly followed by principal investigator for the completeness of data collection. The data extraction format was assessed by independent physician. Terms used was clear and any correction done during the pre-test before the staring of the main study. Data extraction format was prepared in the English language since the data collectors are professionals. All completed abstraction format was examined for completeness and consistency during data management, analysis by principal investigator so that data was intensively cleaned before analysis and coded.

Data analysis

The data was checked and cleaned by principal investigator on daily bases during data collection for completeness, inconsistencies, then coded, entered, cleaned and analyzed using SPSS version 23 and STATA Version 13. Histogram was used to check for normality distribution of the numerical variable. Median and interquartile range was used for not normally distributed numerical variable. Descriptive statistics (Univariate statistical analysis) for the categorical variables, log-rank test with Kaplan-Meier curves and for the continuous variables Cox proportional hazard regression was used. A p-value of <0.25 was considered to include as potential predictors to full model. Statistical significance was declared at $P<0.05$ in the final model. Proportionality assumptions was checked by including time-dependent covariates in the model and all time-dependent covariate was significant. Multicollinearity was checked between independent variables and variance inflations factor (VIF) value was not 10 or approximate to 10 (0.1 for tolerance and 10 for VIF rule), there was no multicollinearity. The possible interactions considered were tested. Since no statistically significant result seen, the interaction variables were not included in model.

Result

Socio demographic, Clinical and biological profile

For this review, two hundred and ninety-two (292) medical records of CVA cases are analysed. One hundred and sixty-three (55.8%) were women, one hundred and sixty-eight (57.5 %) were between the ages of 55 and 85 and one hundred and sixty-three (55.8) were urban. One hundred and ninety eight (67.8%) patients had a positive history of hypertension, while sixty-nine (23.6%) had a positive history of diabetes mellitus. A total of 292 patients with CVA cases were diagnosed with an ischemic stroke of 196 (67.1%) (Table1)

Table 1: Socio demographic, Clinical and biological profile of CVA patients who got treatment in ACSH

Variables		Frequency	Percent
Gender	M	129	44.2
	F	163	55.8
Age category	Less than 55	109	37.3
	55-85	168	57.5
	Greater than 86	15	5.1
Residence Category	Rural	129	44.2
	Urban	163	55.8
History of Hypertension	Yes	198	67.8
	No	94	32.2
History Diabetes mellitus	Yes	69	23.6
	No	223	76.4
Types of Stroke	ischemic stroke	196	67.1
	Hemorrhagic stroke.	96	32.9

Diagnosis confirmation investigation tool and hospital stay profile

Most important diagnosis confirmation investigation tool used for cerebrovascular accident patients, Ayder Comprehensive Specialized Hospital was CT scan (98.6%) and MRI (1.6 %). Two hundred sixty-three (90.1%) of patients were admitted and treated in conventional medical ward (MW) and the rest was in intensive care unit (ICU). Majority of the Patient (72.6%) were stay less than 10 days in the hospitals and 27.4 % of them either censored or died stay in the hospital for less than 20 days. From the total of two hundred ninety-two CVA case patients, forty-two (14.4%) were died during their 20 days of hospital stay. (Table 2)

Table 2: Diagnosis confirmation investigation tool and hospital stay profile of CVA patients who got treatment in ACSH

Variables		Frequency	Percent
Diagnosis confirmation investigation tool	CT	288	98.6
	MRI	4	1.4
Ward name that the patient admitted	Medical wards (MW)	263	90.1
	Intensive care unit (ICU)	29	9.9
	Less than 10	212	72.6

Admission length of stay in days	10-20	80	27.4
Discharge condition or treatment output	Censored	250	85.6
	Death	42	14.4

Survival analysis

Two hundred ninety-two CVA case patients of medical record charts and electronic medical recording database were reviewed their admission history for 20 days from admission date and time to discharge date and time. Two hundred fifty (85.6%) were censored and forty-two (14.4%) were died. Thirty-eight (80.95%) were died with in the 7 days of hospital stay. From forty-two dead patients, thirty-nine (92.9%) had positive history of HTN, eighteen (42.9%) had positive history of DM, and in the case of CVA types, twenty-five (59.5%) were diagnosed as HS.

Since one hundred seventy-nine (71.6%) of patients were diagnosed as IS and two hundred thirty-three (98.4%) were admitted in medical ward, most of the death were happed in medical ward which was 71.4%). When the cases were classified by stroke subtype, 47.1% of patients admitted in ICU who diagnosed as HS died during 10 days whereas was 23.7% died in Medical wards. (Table 3)

Table 3. Survival analysis outcome of CVA patients who got treatment in ACSH

	Variables	Censored	Percent	Death	Percent
Gender	M	109	43.6	20	47.6
	F	141	56.4	22	52.4
Age category	Less than 55	98	39.2	11	26.2
	55-85	142	56.8	26	61.9
	Greater than 86	10	4.0	5	11.9
Residence Category	Rural	113	45.2	16	38.1
	Urban	137	54.8	26	61.9
History of Hypertension	Yes	159	63.6	39	92.9
	No	91	36.4	3	7.1
History Diabetes mellitus	Yes	51	20.4	18	42.9
	No	199	79.6	24	57.1
Types of Stroke	IS	179	71.6	17	40.5
	HS	71	28.4	25	59.5
Diagnosis confirmation investigation tool	CT	246	98.4	42	100
	MRI	4	1.6	0	0
Ward name that the patient admitted	Medical wards	233	93.2	30	71.4
	ICU	17	6.8	12	28.6
Admission length of stay in days	Less than 10	174	69.6	38	90.5
	10-20	76	30.4	4	9.5

Kaplan-Meier survival curves and log rank test among categories of the variables

Patients without history of hypertension have significantly higher survival probability compared to those who had history of hypertension (log rank, p<0.05). The survival probability for CVA without history of diabetes mellitus were significantly higher than those who were free (log rank, p<0.05). Patients diagnosis for ischemic stroke had higher probability survival time compared with hemorrhagic (log rank, p<0.05). Patients who admitted in intensive care unit had lesser survival probability compared with conventional ward (log rank, p<0.05) (Figure 1).

Increasing age also had significant for the survival, when the patients age more than 85 years old the probability survival is less than compared with young and adult age. Gender difference was not important for the survival of CVA patients. Whether the patient had history of any biological factors like HTN and DM the survival time was almost the same during their hospital stay.

Patients came from either urban or rural had almost the same probability of survival specially at the very binging, but when the across survival time assessed, from day 5 to 10 days of hospital stay, patients came from urban had less survival time compared to rural.

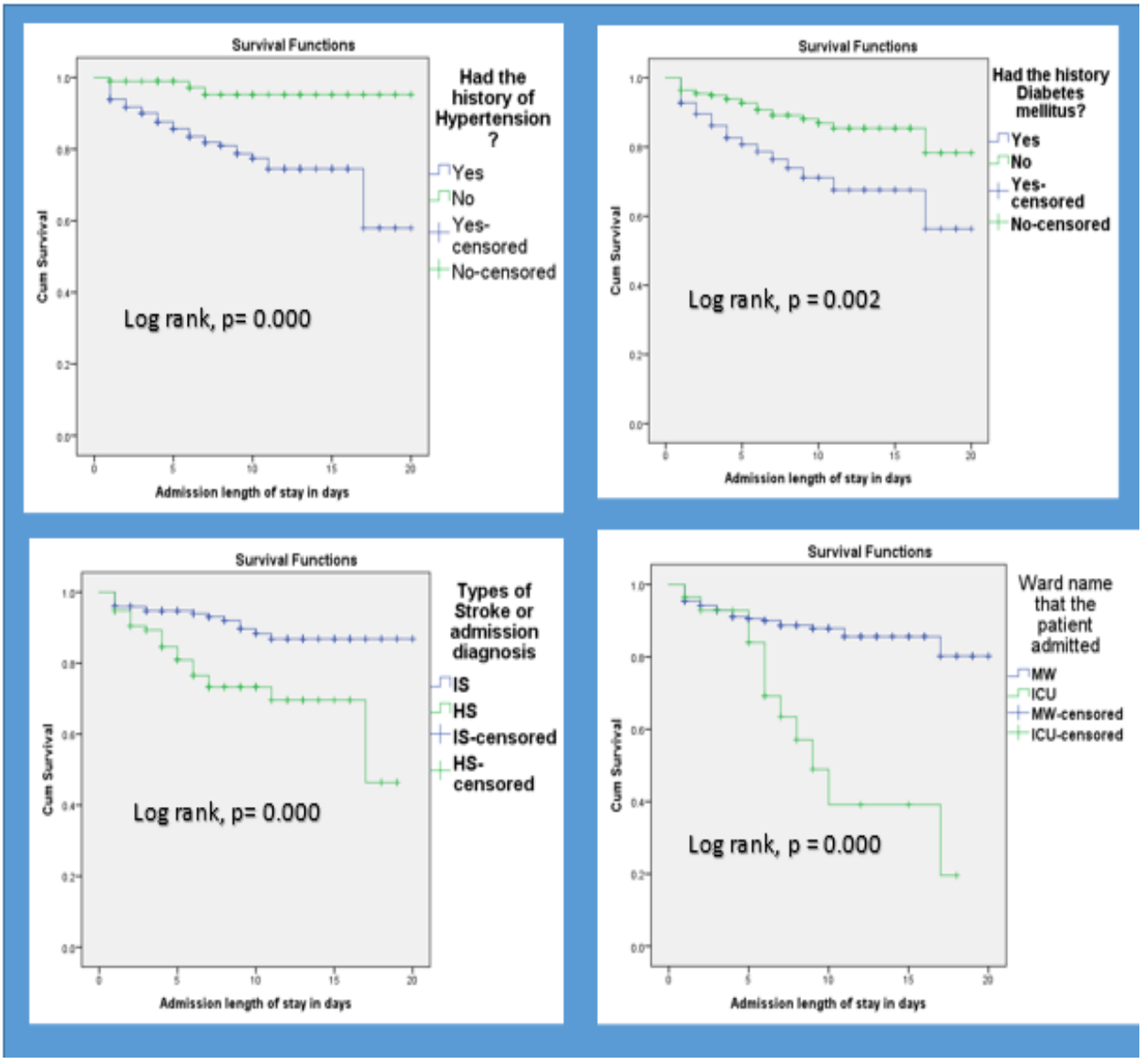

Figure1: *Survival curves for CVA patients according to their HTN history, DM history, Admission diagnosis and treatment ward in ACSH.*

Factor associated with survival rate CAV patients

Interpretation

The interpretation from the result of the final model is based on the hazard ratios. The coefficient of a categorical explanatory variable in the model can be interpreted with the reference category and between groups for the categorical covariates. For a continuous coefficient, explanatory variable is also the estimated change in the logarithm of the hazard ratio for a unit increase in the value of the explanatory variable provided that the other variables in the model are kept constant.

Thus, the interpretation of factors associated with CVA that are included in the final proportional hazard model for patient who admitted and follow their treatment in ACSH is as follows.

Patients with history of hypertension is supposed to be significant both clinically and statistically. The multivariate cox regression analysis of this study also showed that, patients who had positive history of hypertension were 4.8 times more likely to die as compared to those free of hypertension. (HR=4.8, 95%, CI= 1.486 to 16.018, P= 0.009).

Similarly, variables that are found to be significantly associated with the survival of patients in the fitted Cox regression model were positive history of diabetes mellitus, admission diagnosis as hemorrhagic stroke, admission place in intensive care unit and increased age. Patients with diabetes mellitus had double or 2 times more likely to die as compared with normal blood sugar level. (HR=2.0, 95%, CI= 1.086 to 3.789, P= 0.026). The 95% confidence interval indicates that the hazard rate goes to a maximum of 3.789 and a minimum of 1.086. The hazard ratio for patients who diagnosed as hemorrhagic stroke also was 2.110. This explains that patients who got hemorrhagic stroke had 2 times hazard faced compared with who diagnosed as ischemic stroke and when the 95% confidence interval also assessed, the hazard rate goes to the maximum of 4.16. (HR= 2.110, 95%, CI= 1.070 to 4.160, P= 0.031)

The health care unit or place admission like general conventional ward and intensive care unit mattered for the survival of CVA patients. Cases admitted in intensive care unit had almost 2.5 times more likely to die as compared from those who were in medical wards. (HR= 2.48, 95%, CI= 1.166 to 5.306, P= 0.018)

Increasing age had statistically significant for the survival of CVA ceases, the mean age of this study cohort was 60.97 years. The estimated hazard ratios for patients whose age greater than 86 years old had 5.1 compared with their reference groups. This indicates that, being older age with CAV cases had 5 folds of the probability to die. (HR= 5.1, 95%, CI= 1.725062 to 15.48798, P= 0.003) (Table 4)

Table 4: *Multivariate Cox- regression of variables of CVA patients who got treatment in ACSH, form January, 2015 to August, 2016*

Variable name	Hazard ratio (95% CI)	P value
History of hypertension	4.87(1.486-16.018)	0.009
History of Diabetes mellitus	2.029(1.086-3.789)	0.026
Admission diagnosis	2.110(1.070-4.160)	0.031
Ward Name	2.487(1.166-5.306)	0.018
Age	5.168(1.725-15.487)	0.003

Discussion

Cardiovascular accidents or stroke is becoming more common in developing country also. Ethiopia is one the fast-developing country especially since last ten years. Communicable disease was the most concern of the government, but now chronic diseases like stroke is becoming more common cases. Survival analysis is one of the technique to evaluate prevention methods and assess prognostic factors of treatment.

In this study, 14.4% of patients died during 20 days of hospital admission stay (with 7.64 days of median). About 80.95% of death occurred in 7 days of stay. Positive history hypertension and diabetes mellitus, ischemic stroke sub-type, admission ward type and increasing age were statistically significant survival of stroke patients. This output was compared with study conducted in Nigeria University Teaching Hospital for stroke patients admitted patients within one year, 76.2% deaths occurred within the first week. Study conducted about in-hospital outcome of stroke in south Ethiopia, showed that stroke mortality was 14.7% with median hospital stay of 9 days [26-27]. The outcome of this study was consistent with finding of the above study in Ethiopia. But the death during the first week occurred was more compared with other African country. This difference might be due the health facility set up like health care professionals, availability of life support medical equipment, fast stroke emergency services and availability of nearby well set up Hospitals.

This study showed that positive history of HTN increased the rate of mortality. Patients with history of HTN had 4.8 times higher risk of dying compared with normal blood pressure. Study conducted in Europe showed that the risk increased by 4.2% within 14 days and also other study in Africa, Gabon the risk of dying for patients with high blood pressure was 4.5 times [31, 41]. The result of this study was in agreement with the above cited finding. As the status blood pressure record the vital for most of healthcare services, patients might know any time their record and got medical attention and life style modification counseling by health care providers. Due to this case, patients might have similar risk with other countries.

Other important factors included in this study was diabetes mellitus. Patients who had the history of DM had 2 times more likely to die as compared to those normal blood glucose level. The research conducted in United States of America showed that stroke patients with diabetic were at a 2-fold higher risk of mortality. Other researchers conducted in Africa also showed that the risk of stroke with high level of blood sugar was higher [44-45]. The result of this study also matched with the aforementioned researches. Knowing blood glucose level is not expensive and could be tested at any healthcare level. Once patients knew their status, controlling blood sugar level by appropriate dietary, physical exercise and taking medication. People live in Ethiopia also have an access to do tests and got proper medical counseling about management of diabetes mellitus like other countries and this might be the cause for finding this study output was similar with other studies.

From two types of stroke happened, patients who diagnosed as HS had more chance to die compared with IS. The risk of death for haemorrhagic stroke (HS) diagnosed patients had 2 times more likely to die as compared from ischemic stroke (IS) cases. The study conducted in Denmark about the severity comparison between hemorrhagic and ischemic stroke showed that patients who admitted as HS had 1.6 times riskier [46]. The study about in-hospital outcome of stroke in South Ethiopia, Hawasa showed that the risk of dying after hemorrhagic stroke was about four times higher than after ischemic stroke [27]. When the result of this study assessed, the risk of dying due to HS is less than Hawasa hospital and more than other developed countries like Denmark. The level of knowledge of health care providers (availability of specialist and sub specialist doctors), availability of advanced investigation machines and better ward patient care might make the

difference that ACSH was better than other Ethiopian Hospital output. But patients with HS was riskier in this study site than developed countries and the reason also might be the advancement of health care provision and nearby availability of stroke centers.

According to the output of this study, the difference between treatment wards was statistically significant. From the total of 29 patients admitted in ICU 12 (41.4%) died. Whereas from 263 cases treated in MW only 11.4% death occurred. Patients admitted in ICU had almost 2.5 times more likely to die as compared from those who were admitted in MW. 47.1% of patients admitted in ICU who diagnosed as HS died during 10 days whereas was 23.7% died in Medical wards. The study conducted in Europe and Asia about the effect on survival of stroke units versus general medical wards showed that, among patients with cerebral hemorrhage 10-day case fatality was 24.5% in ICU and 51.6% (*P*5.004) in MW [44,46]. The result of this study was disagreed with the above cited findings. The cause of this difference might be the stroke unit in Europe was more advanced than the study site, care giving health professionals experience and capacity, lack of availability of appropriate medications and lack standard ICU admission criteria which differs from compared study sites.

The mean age of CVA cases were 60.97 years, and 62.6% of was aged >55. The result of this study found that being close to old age group 5 times more likely to die compared with young age. Study conducted in Africa and Europe about the mortality factors showed that for patients more than 70 years old had 5 to 6 times more at risk than young ages. Research conducted about functional recovery after stroke on a matter of age showed that the good outcome was highest in age group 18-35 years and steadily decreased by 3.1% to 4.2% per decades until age 75 with steep drop thereafter [16,31-33]. The result of study met the other studies. Even though the onset of stroke could be to any one any time and at any age, the risk increases with age.

Strength and limitation

Strength

Patient data reviewed from both hardcopy of patient chart and EMR database. Recording patient data in electronically is important to know the accurate time of any care giving interactions, the interaction time of any health record activities picked form EMR database.

Limitation

Specially during taking general examination medical recording incompleteness is detected in patient charts and EMR. It was better got and analysis about the smoking and alcohol in-take status. Since the study design was retrospective cohort, it was difficult to get more variables.

Conclusion and recommendations

Conclusion

The hazard rate of patients was high at the earlier time and the death occurred in intensive care unit was more. Hypertension was the most common risk factors for both types of cardiovascular accident. Ischemic stroke, diabetes mellitus and increasing age were also the associated factors for the survival.

Recommendations

- Prevention and control on chronic diseases like hypertension and diabetes mellitus is recommended to reduce severity of stroke
- Intensive care unit (ICU) should be empowered by specialized health care professionals and advance life support medical equipment to reduce stroke mortality.
- Imaging investigation machines and life supporting medical equipment should be available in emergency unit to decrease the early mortality.
- Further study should be conducted by adding different variables which are not included in this study

Ethics approval and consent to participate

This study was conducted after gaining ethical clearance from the College of Health Sciences, Mekelle University's ethical review committee. The study settings also gave research approval. To participate in the study, each participant had given written and oral consent.

Consent to publish

Not applicable!

Availability of data and materials

The data supporting the findings in this article are presented with the manuscript in the section of 'additional supporting files'

Competing interests

All the authors declare that we have no any competing interest.

Funding

No funding agent

Author's contributions

TA and AG participated in the Conception of the design and methods; Data collection, analysis and interpretation were carried out by TA, AG; all authors Draft the manuscript, read the manuscript and approve its submission.

Acknowledgment

The authors would like to thank the Mekelle University for provision of the opportunity and ethical clearance to do this research. The authors also want to express appreciation for all participants who spared their valuable time to share their experiences of knowledge, attitude and personal experience to wards cerebrovascular accident patients and associated factors.

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