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"Speech Difficulties Following A Stroke in Right Hemisphere in Brain: A Study in Zainul Haque Sikder Womens Medical College & Hospital, Dhaka,Bangladesh"

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Abstract **Original Research Article**

Introduction: Clinical practice shows that right-hemisphere cerebral strokes are often accompanied by one speech disorder or another. ***Objective*:** To find out Speech difficulties following a stroke in right hemisphere in brain. ***Methods:*** 101 individuals with dysarthria following stroke with mean age of 42.5 years participated in the study. Presence of stroke was confirmed by medical professional based on CT and MRI along with clinical evaluation. Perceptual assessment of speech was carried out and participants were classified into different dysarthria types based on Mayo clinic system by an SLP followed by assessment of speech intelligibility and global dysarthria severity**.** ***Results:*** The aim of the study 101 patient's analyzed Speech difficulties following a stroke in right hemisphere in brain. Questions of the lateralization of speech functions are discussed, with particular reference to the role of the right hemisphere in speech activity and the structure of speech pathology in right-hemisphere foci. Clinical variants of speech disorders, such as aphasia, dysprosody, dysarthria, mutism, and stutter are discussed in detail. ***Conclusion:*** Types of speech disorders are also discussed, along with the possible mechanisms of their formation depending on the locations of lesions in the axis of the brain (cortex, sub-cortical structures, stem, and cerebellum) and focus size.

Key words: speech function lateralization, speech disorders, right-sided strokes.

INTRODUCTION

Worldwide, stroke is the second leading cause of death, responsible for at least 4.4 million (9 percent) of total 50.5 million deaths each year [51]. Currently, Stroke is the second leading cause of death in the western world ranking after heart diseases and before cancer and causes 10% of deaths worldwide [8]. According to the World Health Organization, 15 million people suffer stroke worldwide each year. 5 million die and another 5 million are permanently disabled [19]. Stroke is defined by WHO as rapidly developed clinical signs of focal disturbance of cerebral function lasting for more than 24 hours or leading to death without any apparent cause other than vascular origin [27].The brain is an exciting area in neurology as it is complex in anatomy and in function. With the advancement of age in addition to decay, the brain becomes more prone to get many complicated life threatening diseases, these will need appropriate attention in time. Stroke is one of such condition which is the burning topic in this new millennium since it is not only a major killer but also a cause of disability in the world as well as in Bangladesh [41]. At the first stage of examination of a patient with stroke, the neurologist has to determine not only the etiology of the stroke, but also the question of the topical diagnosis of the focal brain lesion. One of the first questions is that of the lateralization of the stroke. The main criteria for identifying the lesioned side are usually the presence or absence of speech disorders and the side of the sensorimotor defect affecting the limbs and face. As a rule, in left-hemisphere strokes, particularly in the acute stage, the right-sided limb deficit is combined with speech disturbances, though the neurologist is not infrequently faced with the situation in which one or another speech disorder is combined with motor or sensory abnormalities in the left limbs. In this situation, the type of speech disturbance and its location along the brain axis (cortex, subcortical structures, stem, and cerebellum) are particularly important. The diagnosis of acute cerebrovascular lesions has now been significantly simplified by the introduction of neuroimaging methods into neu-rological practice. However, cases of speech disorders in right-hemisphere strokes, their causes and clinical features, and the associated questions of the lateralization of speech functions continue to be discussed and this question is very relevant in theoretical and practical neurology. Existing clinical observations have provided grounds for some re-examination of the stringent theory of the later alization of brain functions and have provided deeper insights into the organization of speech functions and the structure of speech pathology.

Literature Review

Stroke is one of the major chronic illnesses world-wide that health-care organizations will need to address for the next several decades. The nerve cells are responsible for controlling various parts and processes within the body. If the cells cannot function properly, the body parts they are responsible for controlling also cannot functioning properly. About a third of all strokes are preceded by transient ischemic attacks (TIA), or mini-strokes, that temporarily interrupt blood flow to the brain. While TIAs cause similar symptoms (such as sudden vision loss, or temporary weakness in a limb), they abate much more quickly than full flexed strokes, usually within a few hours, sometimes as quickly as a few minutes [10]. Stroke has described the following effects of brain attack- weakness or paralysis on one side of the body that may affect the whole side or just arm or leg and the weakness or paralysis is on the side of the body opposite the side of the brain affected by the stroke, spasticity, stiffness in muscles, painful muscles spasms, problems with balance or co-ordination, problem using language, including having difficulty understanding speech or writing (aphasia); and knowing the right words but having trouble saying them clearly (dysarthria), being unaware of or ignoring sensations on one side of the body, pain, numbness or odd sensations problem with memory, thinking, attention or stroke, being unaware of the effects of a stroke, trouble swallowing (dysphasia), problem with bowel or bladder control, fatigue, difficulty controlling emotion, depression and difficulties with daily tasks [43]. There are some modifiable or preventable risk factors for stroke. The stroke usually refers to the patients who have had Cerebrovascular Accident (CVA) as the results in circulatory defects in which the symptoms have continued for more than 24 hours and it is due to a lesion affecting the opposite side of the cerebrum [12]. A Stroke is an acute medical emergency. Stroke (also called "Brain Attack") is disease of the circulatory system caused by the rupturing or the blockage of an artery. In middle aged and older women, approximately 70% of strokes are thromboembolic (caused by a blockage from a blood clot), 15% consist of intracerebral hemorrhage, and 10% of subarachnoid hemorrhage. Depending on where the rupture or blocked artery leads, this part of the brain does not get oxygen. This can result in permanent brain damage, disability and sometimes death [25]. Cerebral vascular accident (CVA) or stroke is the most common disabling neurological disease of adulthood [46]. It may be defined as an interruption in the blood flow so that an adequate supply of oxygen and nutrients fail to reach portion of the brain. Medical practitioners use the term, often abbreviated as CVA, for stroke. A stroke can occur in any part of the brain the cerebral hemispheres, the cerebellum or the brainstem [5]. A cerebrovascular accide3nt is a rapidly developed clinical sign of a focal disturbance of cerebral function of presumed vascular origin and o more than 24 hours duration [84, 57]. Clinical signs of stroke develop suddenly due to interruption of blood flow to the brain and lasts more than 24 hours. War low [60] defined the stroke or CVA as rapidly developing clinical symptoms and or signs of focal time‘s global loss of cerebral function with symptoms lasting more than 24 hours leading to death with no apparent cause other than that vascular origin. World health Organization (WHO) supports this definition of CVA. When the severity of stroke last less than 24 hours, it is known as transient ischemic attack (TIA). It is not a stroke but a warning for a forth coming stroke. In TIA no symptoms are found [46]. Stroke or cerebrovascular accident (CVA) does not represent a single disorder but rather a variety of disorders characterized by the sudden onset of neurological deficits brought about by vascular injury to the brain. The most typical manifestation of CVA is hemipheresis orhemiplegia on the side of the body contralayeral to the site of CVA. One study on the people of Bangladesh shows that the 75.59% of all stroke patients are men and 24.1%are women where due to large artery atherosclerosis 21.25%, small artery occlusion17.32%, cardio embolism 18.1% other determined etiology 26.7% and undetermined causes 16.53% [26]. Stroke can be classified into two main types-Ischemic and Hemorrhagic. Ischemic stroke includes artherothrombotic, lacunar and embolic infarction .Hemorrhagic stroke includes intracerebral and subarachnoid hemorrhage [60].The most common type of stroke and it is responsible for about 80% of all first ever in a life time stroke.

Objectives

- **General objective**
  - To identify the Speech difficulties following a stroke in right hemisphere in brain.

- **Specific objectives**
  - To find out the prevalence of common secondary complication among the stroke patients.

- To identify the male female ratio.
- To identify the more affected age group.
- To find the occupation of patients with stroke.
- To identify the influencing demographic factors for such exposure group in relation to age, sex, occupation, living area, religion etc.

Methods

The study was carried at Neuroscience Dept. and Speech Disturbances in Right Dominant Hemisphere Stroke Patients a study in Z.H. Sikder Womens Medical College & Hospital, Dhaka, Bangladesh. An informed consent was obtained from each participant of this study. A total of 101 individuals having sudden onset dysarthria due to first ever stroke, whether ischemic or hemorrhagic, confirmed by medical professional based on CT or MRI and neurological examination were selected. The participants were Bangla speaking and their age ranged between 30 to 55 years with average age of 42.5 years. At the time of assessment, participant's onset of stroke ranged from 2 days to 4 years. Participants with altered consciousness, orientation and alertness; having known co-occurring language, cognitive, psychological disorder; having any known premorbid history of speech language, hearing or communication impairments; and having dysarthria due to neurodegenerative conditions, neuromuscular diseases, head trauma or neurosurgery were excluded. However, participants with co-occurring dysphagia were included.

Study sampling and population

The study populations are stroke patients who are admitted in neuroscience stroke management. The sample is chosen convenience sampling. There is developed a semi structural type questionnaire for identifying the common secondary complications.

Inclusion criteria

- Both male and female would include.
- Patient age range is between 30-55 years.

Exclusion criteria

- Patients who would medically unstable.
- Participants who has not speaking and hearing problem.
- Patients who have cognitive problem.
- Patients who are not able to communicate

Data collection method and tools

Data are collected by using a semi structural type questionnaire paper set, developed by the investigators and validated by a jury of experts involved in the management of stroke (clinical physiotherapists), by conducting to interview to collect information. The questionnaire sought information on identification demographic information and musculoskeletal related questions, neurological related questions and cardio-respiratory related questions. The tools used in collecting data would pen and pencils, paper, approved forms and consent forms, reflex stick and a bag for storing these tools.

Data collection procedure

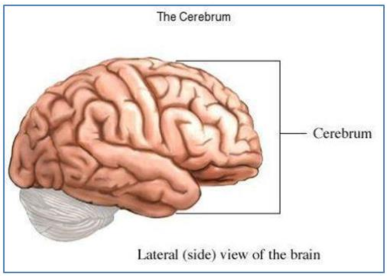
There is a questionnaire for acquiring the participant's demographic information including age, sex, marital status, educational status, occupation, history including types of occupation, disease condition related information such as musculoskeletal related information, neurological related, cardiovascular related and others information. The questionnaire is provided to responsible physiotherapists for patients and also direct to the patients for finding the answers to the questions given in the questionnaire.

Data Analysis

Descriptive quantitative data is analyzed by using "SPSS" 16 software. The coded responses on the questionnaire are then entered on the computer general coding forms. They would analyze using Statistical Package for the Social Science (SPSS) Windows version 16.0. The results would present with the use of simple percentage (%). The collected data is illustrated with tables, bar charts and pie-charts also.

Right-side Stroke (Stroke, Right-side; Right Hemisphere Stroke; Stroke, Right Hemisphere) Definition

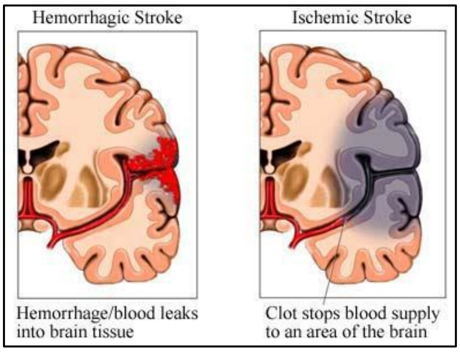
The cerebrum is the largest part of the brain. It is made of a left and a right hemisphere. The right hemisphere is in charge of the functions on the left-side of the body and many cognitive functions. A right-side stroke happens when the blood supply to the right side of the brain is interrupted. Without oxygen and nutrients from blood, the brain tissue quickly dies.



There are 2 main types of stroke: ischemic and hemorrhagic. An ischemic stroke is the most common type of stroke. Causes An ischemic stroke is caused by a blockage of the blood flow, which may be due to:

- A clot from another part of the body like the heart or neck. The clot breaks off and flows through the blood until it becomes trapped in a blood vessel supplying the brain.
- A clot that forms in an artery that supplies blood to the brain.
- A tear in an artery supplying blood to the brain—arterial dissection.
- A hemorrhagic stroke is caused by a burst blood vessel. Blood spills out of the broken blood vessel and pools in the brain. This interrupts the flow of blood and causes a buildup of pressure on the brain.

Hemorrhagic vs. Ischemic Stroke



Rationale

Stroke is a catastrophic event and one of the most common causes of severe disability following neurological damage. Stroke is an important health problem in Bangladesh due to high morbidity and Mortality rate. It is the one of the significant causes of physical Disability in our country. The number of affecting people is increasing day by day due to lack of awareness. It is affecting a large number of individual that creates devastating effect on a family a society as well as in whole country. It is explained broadly about the secondary complication of the stroke patients and this is the most common scenery in the Bangladesh. The world health organization statistics that is, about 10% of the population are disabled by stroke large number of Populations suffer from stroke. Many secondary complications arise, due to lack of awareness of patients and family. So it should be known to everyone about the secondary Complication of stroke. If enough knowledge about the secondary complications after stroke, it will be easy to prevent the further complications. The aim of the study is to find out the Common secondary complications of stroke patients. So it is help for our society and country in both socially and economically. This is very important for the stroke patients focusing on preventing the secondary complications and improving quality of life for people with stroke. Finally for this study participants may be beneficial and practitioner will gain knowledge from this study.

Historical note and terminology

Descriptions of the effects of right hemisphere brain injury on communication started to appear with increasing frequency in the last few decades of the 20th century, approximately 100 years later than modern descriptions of aphasia subsequent to left hemisphere brain damage [78, 85]. The primary role of the left cerebral hemisphere for language in adult humans has not been challenged. Virtually all discussions of phonetic, phonological, lexical, and syntactic impairments revolve around left hemisphere injury. However, language and communication in natural settings involves considerably more than the “nuts and bolts” of the basic building blocks of literal language that are sensitive to left hemisphere brain damage. A patient can score well on most parts of an aphasia battery but still fare very poorly in natural communicative settings that require supralinguistic competence, such as appreciation of context, inferential ability, and understanding an audience. The nuances conveyed by nonliteral language, such as metaphor and irony, the meaning indicated by speech prosody, and the apprehension of a speaker's main point in a story or conversation, underscore the relevance of the much wider range of language and language-related skills that are often affected by right hemisphere brain damage. The term “right hemisphere syndrome” is sometimes used as a label for the collection of deficits associated with right hemisphere brain damage. Consideration of the right hemisphere's contribution to language and related cognitive domains provides a richer understanding of healthy and impaired communication. Gardner and colleagues were among the first to investigate how right hemisphere brain damage might limit patients' semantic processing in studies that led directly to later work. For example, Gardner and Denes described right hemisphere brain damaged patients' difficulty with connotative meaning expressed in pictures: patients had trouble choosing an appropriate pictorial analog for a concept such as “wealth” from an array that included an arrow pointing up and another arrow pointing down [85]. Winner and Gardner reported a related tendency to be concrete: when asked to select an appropriate picture to represent the meaning of a familiar metaphor ("heavy heart"), they would choose a man staggering under the weight of an oversized heart rather than a picture of a man crying [86]. Since then, investigation of right hemisphere brain damage patients' communication impairments has yielded an extensive catalogue of abnormalities [87]. In recent years, the catalog of deficits relevant to language and communication has expanded to include social and cognitive impairments tied to, for example, Theory of Mind (ToM), as will be discussed below. The literature leaves some broad issues unresolved. One question is whether a single core problem can account for a range of impairments. Beeman, for example, proposes that the right hemisphere plays a relatively large role in "coarse-grained" processing [88]. A second question is whether regions within the right hemisphere act as "centers" with primary responsibility for specific types of processing or, alternatively, whether a region simply contributes to normal levels of competence. Deficits can result from right hemisphere brain damage under either interpretation.

RESULTS

The aim of the study was to 101 patient's analyzed Speech difficulties following a stroke in right hemisphere in brain. Questions of the lateralization of speech functions are discussed, with particular reference to the role of the right hemisphere in speech activity and the structure of speech pathology in right-hemisphere foci. Clinical variants of speech disorders, such as aphasia, dysprosody, dysarthria, mutism, and stutter are discussed in detail. The results of the study are discussed under the following headings; speech disorders of dysarthria, factors contributing to speech intelligibility and global severity of dysarthria. Among individuals with dysarthria following ever stroke, difficulty in more than one speech subsystem like respiration, phonation, articulation, resonation, prosody was present among participants of the study. Table 1 show the number of people in whom speech sub-systems were affected the speech disorders observed. Speech disorders displayed by individuals with dysarthria following stroke were; labored and shallow respiration, reduced breath support for speech in metabolism sub-system & hoarse, harsh, breathy and strained voice quality in pronators, inexact articulation and slow DDK in pronunciation, hyper nasality in resonator and slow speech rate, monotony, and reduced stress in accentual system. It may be noted that among the speech disorders of speech defect, inexact articulation was commonest followed by slow speaking rate, gruff voice. Classification of speech defect supported the pioneer salad dressing clinic organization disclosed that the incidence of UUMN dysarthria highest (50%), followed by spastic (31.1%), ataxic (12.5%) and hypokinetic (6.2%). Characteristic of dysarthria shown by its different types were also analyzed in this study. Speech disorders of UUMN type included labored breathing, imprecise phonemes, hoarse voice, breathy voice, low loudness. Resonance was we analyzed a group of 50 patients treated at the Department of Neurology, University Hospital Osijek, who survived ischemic stroke at least 3 weeks ago and the most 6 months ago. Most of them were attending an outpatient clinic, while 6 patients were still hospitalized for stoke.

Table-1: Frequency of occurrence and percentage of commonly observed speech Characteristics in individuals with dysarthria following first ever stroke (n=101)

Speech subsystem affected	N	(%)	Speech disorders	N	%
			Labored	14	29.2
Respiration	15	41.7	Shallow	16	33.3
			Reduced breath support for speech	14	29.2
			Low pitch	6	12.5
			Reduced loudness	14	29.2
Phonation	26	85.4	Hoarse	11	42.3
			Harsh	8	30.7
			Strained	7	26.9
			Breathy voice	11	22.9
			Imprecise articulation	35	72.9
Articulation	27	77.1	Irregular articulatory breakdown	3	11.1
			Slow DDK	24	88.8
Resonance	11	22.9	Hyper nasality	8	16.7
			Slow rate of speech	31	64.6
Prosody	22	66.7	Monotone	15	68.1
			Excess stress	5	4.95

Age of the participant Analysis reveals that among the 101 participants who had suffered from secondary complication of stroke, the highest participants in between 50-55 years, 15% participants in between 45-50 years, 25% and participants in more than 40-45 years, 30% participants in between 35-40 years 20% participants in between 30-35 years 10% (Figure-1) .

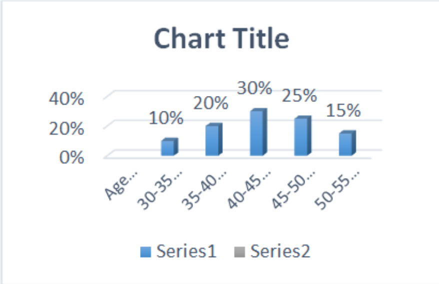
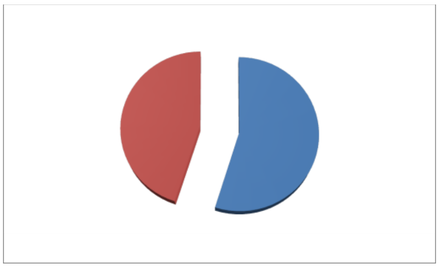


Fig-1: Age of the participant Right Hemisphere Stroke patients

Living area of the participants in this study, the people, who lived in rural, were more affected than the people who lived in urban. Among these 55% (n=101) were in Rural and 45% (n=101) were in urban region (Figure-2).



Urban, 45% Rural 55%

Fig-2: Living area of the participants

Table-2: Distribution of percentage and occurrence of individuals with dysarthria following stroke across various factors, speech intelligibility and global severity (n=101)

Factors	Total		Global Severity					Speech Intelligibility		
			Frequency (N)					Frequency (N)		
	N	%	Mild	Mod	Sev	Min	Mild	Mod	Sev	Extrm
				Age	(in years)					
≤ 30	11	10.89	1	9	1	1	0	9	0	1
>40 & <55	60	59.41	47	9	5	15	30	9	5	1
≥ 55	30	29.7	17	10	3	4	16	8	2	0
				Gender						
Male	78	77.23	58	12	8	15	41	20	1	2
Female	23	22.77	15	5	3	8	12	2	1	0
				Systemic diseases						
HTN	82	81.19	55	23	4	14	42	22	3	1
HTN, DM &/or IHD	17	16.83	16	1	0	6	10	1	0	0
None	2	1.98	0	1	1	1	0	1	0	0
				Lesion Type						
Non-hemorrhagic	84	83.17	59	24	1	14	46	23	1	0
Hemorrhagic	17	16.83	7	6	4	4	6	3	2	2
				Lesion location						
Cortical	21	20.79	16	5	0	0	18	3	0	0
Sub-cortical	35	34.65	28	7	0	12	18	5	0	0
Combined	34	31.3	19	8	7	8	12	6	6	2
Cerebellar	9	8.91	2	7	0	2	2	5	0	0
Brain-stem	2	1.98	1	1	0	0	1	1	0	0
				Lesion extent						
Localized	88	87.13	52	30	6	21	58	7	1	1
Widespread	13	12.87	8	2	3	2	6	2	2	1
				Lesion side						
Right	41	40.59	30	11	0	10	25	6	0	0
Left	45	44.55	40	5	0	25	10	20	0	0
Bilateral	15	14.85	9	2	4	1	8	4	1	1

Perceptual assessment of global severity and speech intelligibility rated by SLP is shown in Table 2. Results of global measure of dysarthria severity revealed that maximum number of individuals presented with mild dysarthria (64.5%) followed by moderate (25%) and very few showed severe dysarthria (12.5%). Speech intelligibility was minimally affected in 16.6% individuals, mildly in 47.9%, moderately in 25%, severely in 6.2%, and extremely in 4.1% individuals with dysarthria following stroke. This shows global severity of dysarthria and speech intelligibility is usually mild but it can range between mild to severe for individuals following strokes. It was observed that severity was higher for individuals with spastic dysarthria for both the measures, that is, speech intelligibility and global severity. Distribution of frequency of occurrence and percentage of individuals with dysarthria following stroke across various factors like age, gender, systemic diseases, lesion type, lesion location, lesion extent, lesion side, dysarthria types, postural control, locomotion, and ADL along with dysarthria global severity and speech intelligibility is tabulated (Table 2).

Table-3: Chi-Square values showing association of factors with global severity and speech intelligibility (n=101)

Factors	X2	Global Severity	p	Speech Intelligibility		
		df		X2	df	p
Age	3.203	4	>0.05	10.131	8	>0.05
Gender	0.186	2	>0.05	2.449	4	>0.05
Systemic diseases	5.368	4	>0.05	13.024	8	>0.05
Lesion type	9.712	2	<0.05*	10.768	4	<0.05*
Lesion location	17.464	8	<0.05*	22.238	16	>0.05
Lesion extent	5.193	2	>0.05	5.481	4	>0.05
Lesion side	9.463	4	>0.05	10.795	8	>0.05
Dysarthria Type	14.297	6	<0.05*	16.313	12	>0.05
Postural control	8.343	4	<0.05*	24.822	8	<0.05*
Locomotion	15.641	4	<0.05*	16.122	8	<0.05*
ADL	12.319	4	<0.05*	13.106	8	>0.05

Chi-square was applied to find association of severity of global dysarthria and speech intelligibility with age, gender, lesion type, lesion location, lesion extent, lesion side, systemic diseases, dysarthria type, postural control, locomotion and ADL. It can be observed from Table 3 that statistically significant association was obtained for global severity of dysarthria with its types ($p<0.05$), lesion type i.e., non-hemorrhagic vs. hemorrhagic stroke ($p<0.05$), lesion location ($p<0.05$), postural control ($p<0.05$), locomotion ($p<0.05$) and activities of daily living ($p<0.05$), however, no association obtained for age, gender, lesion type, extent, and side, and presence of systemic diseases. For speech intelligibility, association was noted with only lesion type ($p<0.05$), postural control ($p<0.05$), and locomotion ($p<0.05$). Results for each factor is discussed separately (table 3). For all of the patient's hemispheric lateralization of the brain lesion was registered with CT scan. We divided patients according to CT results in 4 groups: TACS (total anterior circulation syndrome); PACS (partial anterior circulation syndrome); LACS (lacunar syndrome); POCS (posterior circulation syndrome) [32].

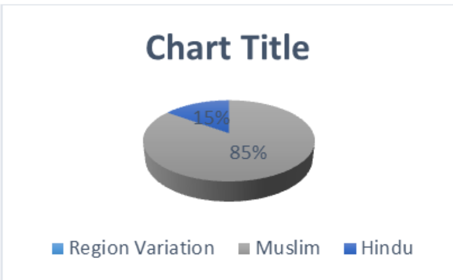


Fig-3: Region Variation of Stoke Speech disorders

Patients with negative CT scan, and those with brain stem infarcts, were excluded from the study. We excluded patients with prior history of psychiatric disorders shows clinical characteristics of the investigated group. For detection of emotional disorders we used Crown-Crisp Experiential Index (CCEI), which consists of 48 questions in 6 scales: scale of generalized anxiety, folic behavior, obsessive behavior, somaticized anxiety, depression and hysteric behavior [92]. Region Variation of Stoke Speech disorders. Among the participants muslin 85% and Hindu 15% (Figure-3).

Table-4: Presence of emotional disorders according to lateralization of lesion (n=101)

Emotional disorder	Right hemisphere lesion		Left hemisphere lesion		P-value
	M	SD	M	SD	
General anxiety	6.62	3.39	5.04	3.35	1.68
Phobias	6.04	2.41	5.63	2.89	0.55
Obsessive behavior	7.04	2.34	6.38	3.18	0.85
Somaticized anxiety	7.31	2.41	5.58	3.56	2.06
Depression	6.81	2.61	5.92	3.69	0.00
Hysteric behavior	3.12	1.73	4.42	1.69	1.71
	N=56		N=45		

According to patients gender emotional disorders are more common among female than male patients. Statistically significant difference has been found on scale of generalized anxiety ($p< 0.05$), scale of depression ($p< 0.05$) and scale of phobic behavior ($p< 0.01$) (Table 4).The objective of the study was to find the common complications among stroke patients. The subject matter were two-fold; firstly, to study speech disorders, speech intelligibility and global severity of dysarthria in individuals following stroke, and secondly, to find association of speech intelligibility and global severity with various factors. Demographic factors it can be observed from Table 2 that among participants of the study, occurrence of dysarthria was higher for individuals above 55 years, followed by those between 30-55 years and very few below 30 years. More number of males showed dysarthria with higher ratings on global severity speech difficulties following a stroke in right hemisphere in brain intelligibility when compared to females. Most individuals with stroke had presence of at least one systemic disease like HTN, DM, and/or IHD. Presence of HTN, whether in isolation or co-occurring, was seen among most participants. However, there was no significant association obtained for age, gender and systemic disease with both speech intelligibility and global dysarthria severity on chi-square (Table 3). Etiological factors among the etiological factors, the type, location, extent and side of lesion were studied in persons having dysarthria following stroke. It was observed that the number of individuals having dysarthria due to non-hemorrhagic stroke was higher compared to hemorrhagic stroke. Higher ratings were obtained for individuals with hemorrhagic stroke on global severity and speech intelligibility than for non-hemorrhagic (Table 2). Presence of multiple lesion sites was common compared to isolated lesions leading to dysarthria. Further it was observed that the lesions located at multiple sites were frequent when occurred in cortical, sub-cortical, and/or brainstem and among isolated lesions, sub cortical site was frequent than isolated cortical, brainstem or cerebellar. Individuals having multiple lesion location obtained moderate to severe ratings on global severity and speech intelligibility compared to isolated lesions. It was noted that 41.7% participants had left hemispheric lesions, 20.85% had right sided and 37.5% had bilateral lesions leading to dysarthria. More number of individuals had dysarthria when the lesion was in left than in right hemisphere among the participants of present study. While analyzing effect of lesion side on severity of dysarthria, it was noted that in left sided lesion speech intelligibility and global dysarthria severity was higher compared to right. Moreover, lesions were localized in 79.2% of individuals but widespread in 20%. Chi-square analysis revealed a statistically significant association of lesion type with speech intelligibility and global dysarthria severity. Though, association of lesion location was seen only with global severity but not with speech intelligibility. This indicates that both measures, global severity and speech intelligibility, varies with stroke type and that dysarthria is usually severe among individuals with hemorrhagic stroke. However, no significant association was obtained for lesion site, lesion extent, with global severity and speech intelligibility ratings. Type of Dysarthria Occurrence of UUMN dysarthria was highest (50%), and followed by spastic (31.1%), ataxic (12.5%) and hypokinetic (6.2%). Both measures of dysarthria severity, that is speech intelligibility and global severity varied with different dysarthria types. More number of individuals with spastic dysarthria had high global severity but for a majority of persons with UUMN had mild degree (Table 2). Similarly, speech intelligibility was mildly affected in individuals with UUMN type contrary to severely affected speech intelligibility among spastic type. However, statistically significant association of dysarthria types was obtained with global severity but not with speech intelligibility. Locomotion, Postural control and ADL Among the general characteristics of dysarthria, Physical condition, postural control, locomotion and ADL were investigated in this study. Physical condition was impaired in 79.2% (38) with dysarthria following first ever stroke. Many individuals had impaired postural control and like paralysis/weakness of limbs (81%), followed by rigidity or slowness of movements (10%) and spasticity (8%). Among individuals who had some locomotors issues, 33% could not move and were bedridden, 10% could sit with support and locomoted through wheelchair and 56% needed support for walking. Impaired postural control was observed in 53% (26) of individuals however 47% (23) had no postural abnormality. On Chi-square, statistically significant association was obtained for postural control, locomotion and ADL with global severity; however, for with speech intelligibility association was noted for postural control and locomotion but not for ADL. It was also noted that many individuals needed assistance while performing activities of daily living, few where completely dependent and some could manage independently. Feeding issues were also observed in 47% (23) of individuals with dysarthria following stroke.

DISCUSSION

The aim of the present work was to analyze published data addressing speech disorders in right-hemisphere strokes with assessment of the locations and sizes of focal brain lesions, types of speech disorders, and the possible mecha-nisms of their formation. The following clinical variants of speech disorders are recognized in neurological practice: aphasia, dysprosody, dysarthria, mutism, and stutter [1]. In this context, we will consider their appearance in right-hemisphere cerebrovascular lesions. Speech functions and their lateralization. The role of the right hemisphere in speech activity. The functions of speech are to encode thoughts and feelings in the form of language, and to translate external utterances and incoming informa-tion into mental concepts [2]. Four main speech modalities are distinguished – impressive speech, oral (expressive) speech, reading, and writing. Impressive speech includes perception, understanding of oral speech, and its retention in operative memory. Oral (expressive) speech consists of the formation and expression of thoughts and feelings in the form of spoken grammatically and lexically correct words, phrases, and texts, along with the ability to repeat foreign speech and names of objects. Reading is the visual percep-tion and understanding of text. Writing is the formulation and expression of thoughts and feelings by means of writ-ing words and phrases [3]. Each of these speech modalities is a complex functional system consisting of a multiplicity of components supported by the operation and interaction of different brain areas. Lesioning of any brain area impairs the functional system as a whole, i.e., all its modalities are impaired (to different extents and with qualitative specificity) [4, 5]. Speech functions, like other mental functions, are characterized by hemisphere asymmetry and interhemi-sphere interactions [2]. During early childhood, the hemi-spheres are equipotent in relation to speech. Specialization of the hemispheres starts during the second year of life, after which there is a gradual increase in interhemisphere asymmetry, which reaches its greatest extent by adulthood, gradually fading out with further aging [5, 6].Development of lateralization of individual mental functions to one hemisphere leads to reciprocal inhibition of the areas of the other hemisphere linked with this function, i.e., so-called “tonic inhibition” by the other hemisphere. This reciprocity implies suppression rather than elimination of functions (which is important in relation to the rehabilitation of impaired functions).There is several methods for determining the func-tional asymmetry of speech functions [7]. The methods used are dichotic listening and object naming with separate visual stimulation of the visual field. Patients with transec-tion of the corpus callosum or hemispherectomy have pre-viously provided a good model for studies of the speech functions of each hemisphere. The Wada test consists of sequential chemical “exclusion” of the hemispheres by administration of short-acting barbiturates into the carotid arteries [8]. In addition, CT scanning has been used to assess the sizes of the brain lobes, including the size of the “temporal area” [3]. Hemisphere dominance is now identi-fied and speech functions are located using functional neu-roimaging studies: fMRI, single-photon emission computed tomography (SPECT), positron emission tomography (PET), and transcranial Doppler scanning, which allow assessment of speech-related changes in cerebral blood flow and metabolism in the hemispheres. Numerous clinical observations and studies have demonstrated that the left hemisphere is dominant for speech in most people [2, 3]. Only 1–2% of people have right-hemi-sphere speech dominance. The functional asymmetry of the hemispheres is not global in nature, but is partial and dynamic [9]. Thus, the involvement of the right hemisphere in speech processes increases in left-hemisphere epileptic seizures and during recovery after left-hemisphere strokes. It is often said that there is a relationship between the location of brain speech areas and right- or left-handedness [10]. In the European population, “pure” right-handers account for about 40% of the total population, 50–55% being ambidextrous, i.e., to some degree left-handed, and 4.5–10% being “pure” left-handers [11]. Among right-han-ders, 90–96% shows left-hemisphere speech dominance [7]. The question of speech representation in left-handers ini-tially evoked strong controversy. However, the suggestion that hemisphere specialization in left-handers was the mir-ror image of that in right-handers and that the right hemi-sphere was dominant in speech did not receive support. It is now accepted that about 76% of left-handers also have speech representation on the left, while of the remaining 24%, about 14% have bilateral speech representation, with the right hemisphere being dominant in 10%. Overall, right hemisphere speech dominance is much rarer than left-hand-edness. At the same time, the probability of right-sided speech dominance is much higher in left-handers than in right-handers. Apart from left-handers and those with a genetic pre-disposition, atypical speech lateralization is also influenced by factors such as lesions to the left hemisphere of the brain at the embryonic or early childhood stages of development, which leads to a shift in dominance towards the structural-ly unharmed right hemisphere [12]. Displacement of the cerebral mechanisms of speech to the other hemisphere may not be identical for speech and the hands. Social and cultural factors such as illiteracy, the use of tonal languages, and hieroglyphic writing also play some role in the incom-plete lateralization of speech with a predominance of right-hemisphere dominance [9]. Left-hemisphere speech functions in right-handers have been well studied, as lesions produce profound and distinct speech disorders [4, 13]. Less obvious is the involvement of the right hemisphere in speech processes, though sufficient data have now been accumulated regard-ing its contribution to speech-thought activity. The main speech functions of the right hemisphere in right-handers can be identified [3, 14]: regulation, percep-tion, and production of the intonation-melodic aspect of speech, which emphasizes and colors the sense of an ora-tion, the global perception of the schemes of texts, pictures, and life situations, the global understanding of gestures and expressions as components of verbal communication, the operation of speech automatism and stock phrases, the global perception and reproduction of the sound images of words, and the storage of speech automatisms, which are not subject to deconstruction into sound units, in memory. Thus, right-hemisphere speech production is ordered in nature and is manifest as prepared formulas, in contrast to left-hemisphere speech, with is actively constructed.

CONCLUSION

Types of speech disorders are also discussed, along with the possible mechanisms of their formation depending on the locations of lesions in the axis of the brain (cortex, sub-cortical structures, stem, and cerebellum) and focus size. In summary, the results of the study indicate that there is a unit some speech disorders like inexact articulation, slow speaking rate, cacophonous voice, monopitch and monoloudness area unit usually seen in people with speech defect regardless of its kind. UUMN speech defect was most often gift in people with stroke followed by spastic kind. Severity of speech defect, measured by intelligibility and international severity, was typically of delicate severity in most participants though higher severities were additionally noted. Severity was high for spastic speech defect for each intelligibility and international severity. Intelligibility and international severity showed vital association with lesion kind, speech defect kind, and general physical characteristics.

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