The A2DS2 Score As A Predictor Of Pneumonia In Acute Ischemic Stroke

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Abstract: Background: Stroke is the second leading cause of death worldwide. In the acute phase, stroke patients are susceptible to complications like chest infections, cardiac dysfunction, and urinary tract infections. Globally, the incidence of pneumonia among stroke patients is estimated to be around 14%. The A2DS2 score (age, atrial fibrillation [AF], dysphagia, sex, and stroke severity using the National Institutes of Health Stroke Scale [NIHSS] score) is a simple scoring system to find risk of stroke associated pneumonia (SAP). Here our aim is planned to assess the risk of SAP in patients with acute stroke using the A2DS2 score. Material And Methods: This prospective observational study was conducted on patients with Ischemic stroke, time from symptom onset within 7 days and Age > 18 years admitted in tertiary care hospital. NIHSS score and A2DS2 score were calculated on admission. Follow up of all the patients was done during their hospital stay and those who fulfilled Mann's diagnostic criteria for pneumonia were diagnosed as SAP. Result: Out of 110 patients (M:60, F:50, Mean age 60.37+7.07), the commonest comorbidity was Hypertension (85, 77.27%) and the commonest symptom was Facial Asymmetry (73, 66.4%). Among these, 19 (18.8%) patients developed SAP. Patients with SAP had higher mean age, male preponderance, commonest symptom dysphagia, higher NIHSS score and higher A2DS2 score. Patients with acute ischemic stroke who had high A2DS2 scores (5-10) higher risk of developing SAP and worse outcome (P <0.05). Conclusion: In conclusion, patients in the high A2DS2 score group had higher incidence of SAP and non-favourable outcome compared to patients with low A2DS2 scores who had more favourable outcomes [Vyas C Natl J Integr Res Med, 2022; 13(1): 01-08, Published on 26/01/2022]

Key Words: A2DS2 Score, Stroke Associated Pneumonia

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Introduction: Stroke is the second leading cause of death worldwide, with 6.2 million dying from stroke in 2015, an increase of 830,000 since the year 2000. In developing countries, stroke is the main cause of death and disability with an increased burden on caregivers. In India, the incidence of stroke is projected to be around 116-163 per 100,000 population[1]. In the acute phase, stroke patients are susceptible to complications like chest infections, cardiac dysfunction, and urinary tract infections. One-third of stroke patients are prone to these complications and is a major cause of death while also increases the duration of hospitalization[2,3].

Globally, the incidence of pneumonia among stroke patients is estimated to be around 14%[4]. A systematic review reported that the incidence of pneumonia in India is between 22.8% - 32%[5]. The A2DS2 score (age, atrial fibrillation [AF], dysphagia, sex, and stroke severity using the National Institutes of Health Stroke Scale [NIHSS] score) is a simple scoring system developed from the Berlin Stroke Registry cohort and afterwards validated using German stroke registry [6] to find risk of stroke associated pneumonia (SAP). In India, a proper scoring system for clinical trial and clinical practices for patients is currently unavailable[7]. As very few studies have been conducted in India and no study has been done in Gujarat. So, in this study, we planned to assess the risk of SAP in patients with acute stroke using the A2DS2 score and to find correlation between A2DS2 score and outcome of these patients.

Material & Methods: This prospective observational study was conducted on patients who presented with acute ischemic stroke, admitted in medicine Department of tertiary care Hospital Ahmedabad. A total of 110 patients were studied. The study was conducted during the period between august 2019 to October 2020.Written approval from IRB will be taken.

Consent of the Patients or Patient's relatives were taken. All patients admitted with Ischemic stroke verified by Computerized Tomography (CT) or Magnetic Resonance Imaging (MRI), time from symptom onset within 7 days and Age > 18 years included in study. All the patients fulfilling Inclusion criteria were included in the study. Detailed relevant history was taken, and clinical

examination was done in study group according to predesigned and pretested proforma. Patient's demographic, clinical history and detailed past history was recorded. Special attention was paid to patient with risk factors like hypertension, diabetes, dyslipidaemia, Ischemic heart disease, Atrial fibrillation, and previous stroke/TIA. NIHSS score and A2DS2 score were calculated on admission. All patients were investigated in detail. Patient's clinical variables and investigations were recorded. Follow up of all the patients was done during their hospital stay and those who fulfilled Mann's diagnostic criteria for pneumonia were diagnosed as SAP (Mann's diagnostic criteria of pneumonia: based on the presence of ≥ 3 of the following variables: 1. Fever (>38°C), 2. Productive cough with purulent sputum, 3. Abnormal respiratory examination (tachypnoea [>22/min], tachycardia, inspiratory crackles, bronchial breathing), 4. Abnormal chest radiograph, 5. Arterial hypoxemia (PO2 <70mmHg), and 6. Isolation of a relevant pathogen). The data achieved was assessed by standard statistical test. Outcome was recorded in all patients.

Stastical Analysis: The data obtained was coded and entered Microsoft Excel Worksheet. The categorical data was expressed as rates, ratios and proportions and comparison was done using chi square test. The continuous data was expressed as mean ± standard deviation (SD). Kappa agreement was used to correlate the agreements. A probability value ('p' value) of less than or equal to 0.05 was considered as statistically significant.

Results: One hundred ten patients with acute ischemic stroke were included in this study out of which 19 (18.8%) patients developed SAP. Table 1 shows Clinical profile of stroke patients. In our study, mean age of acute ischemic stroke patients with pneumonia (62.52±10.61) was higher than patients without pneumonia (59.94±9.19) but it was statistically not significant. The most common presenting symptom was facial asymmetry (66.4%) followed by hemiparesis (56.4%), slurring of speech (41.8%), dysphagia (36.4%) in studied patients. Among stroke patients who developed SAP, the most common presenting symptom was dysphagia (89.5%) followed by facial asymmetry (73.7%), slurring of speech (73.7%), drooling of saliva (73.7%), hemiparesis (63.2%), difficulty in speech(52.6%).

Table 1: Clinical Profile Of Stroke Patients

Age	Stroke With Pneumonia (N=19)		Stroke Without Pneumonia (N=91)		Total Number Of Patients (N=110)	
	N	%	N	%		
39 to 50 years	0	0%	21	100%	21	19.1%
51 to 60 years	8	26.67%	22	73.33%	30	27.3%
61 to 70 years	6	19.35%	25	80.65%	31	28.18%
More than 70 years	5	17.86%	23	82.14%	28	25.5%
Gender						
Male	13	21.67%	47	78.33%	60	54.5%
Female	6	12%	44	88%	50	45.5%
Symptoms						
Facial Asymmetry	14	73.7%	59	64.8%	73	66.4%
Hemiparesis	12	63.2%	50	54.9%	62	56.4%
Slurring of speech	14	73.7%	32	35.2%	46	41.8%
Dysphagia	17	89.5%	23	25.3%	40	36.4%
Difficulty in Speaking	10	52.6%	25	27.5%	35	31.8%
Mono-paresis	2	10.5%	33	36.3%	35	31.8%
Drooling of Saliva	14	73.7%	15	16.5%	29	26.4%
Altered sensorium	9	47.4%	18	19.8%	27	24.5%
Numbness on one side	8	42.1%	19	20.9%	27	24.5%
Imbalance	5	26.3%	18	19.8%	23	20.9%
Vertigo	5	26.3%	18	19.8%	23	20.9%
Diplopia	5	26.3%	13	14.3%	18	16.4%
Blurring of vision	5	26.3%	9	9.9%	14	12.7%

Table 2 shows Profile of comorbidities and habits in acute ischemic stroke patients. Incidence of pneumonia was significantly higher among patients who had Atrial fibrillation (P = 0.02) and previous history of stroke/TIA (P = 0.0003). Hypertension, diabetes mellitus, dyslipidaemia and IHD were not statistically significant risk factors for incidence of SAP.

In our study, incidence of SAP was statistically higher among patients who had history alcoholism (38.09%) compared to patients without alcohol consumption (12.36%) (P = 0.007). Patients with history of smoking also had higher incidence of SAP (22.5%) in comparison non-smokers (14.29%), but not statistically significant.

Table 2: Profile Of Comorbidities And Habits In Acute Ischemic Stroke Patients

Co-morbidities	Number Of Patients	Stroke With Pneumonia (N=19)		Stroke Without Pneumonia (N=91)		OR (95% CI)	P-value
		N	%	N	%		
Hypertension							
Yes	85	15	17.65	70	82.35	1.98 (0.61 To 6.40)	0.25
No	25	4	16	21	84	1.00 (Reference)	
Diabetes Mellitus							
Yes	46	9	19.56	37	80.44	1.31 (0.49 To 3.54)	0.59
No	64	10	15.62	54	84.38	1.00 (Reference)	
Ischemic Heart Disease							
Yes	48	7	14.58	41	85.42	0.71 (0.26 To 1.97)	0.51
No	62	12	19.35	50	80.65	1.00 (Reference)	
Atrial Fibrillation							
Yes	8	4	50	4	50	5.80 (1.31 To 25.74)	0.02
No	102	15	14.71	87	85.29	1.00 (Reference)	
Dyslipidaemia							
Yes	18	4	22.22	14	77.78	1.46 (0.42 To 5.07)	0.54
No	92	15	16.30	77	83.7	1.00 (Reference)	
Previous Stroke/ TIA							
Yes	18	9	50	9	50	8.20 (2.64 To 25.47)	0.0003
No	92	10	10.87	82	89.13	1.00 (Reference)	
Smoking							
Yes	40	9	22.5	31	77.5	1.74 (0.64 To 4.73)	0.2764
No	70	10	14.29	60	85.71	1.00 (Reference)	
Alcoholism							
Yes	21	8	38.09	13	61.91	4.36 (1.47 To 12.89)	0.007
No	89	11	12.36	78	87.64	1.00 (Reference)	

Table 3 shows Patients distribution according to stroke severity as per the NIHSS score. Overall mean NIHSS score was 9.6±6.7 among all acute ischemic stroke patients.

Mean NIHSS score was significantly higher among patients with SAP (14.7±6.8) than patients without SAP (8.5±6.7) (P <0.0001).

Table 3: Patients Distribution According To Stroke Severity As Per The NIHSS Score

NIHSS score	Stroke With Pneumonia (N=19)		Stroke Without Pneumonia (N=91)		Total (N=110)	
	N	%	N	%	N	%
Score 1 to 4	0	0.0%	39	42.9%	39	35.5%
Score 5 to 15	7	36.8%	29	31.9%	36	32.7%
Score 16 to 20	8	42.1%	23	25.3%	31	28.2%
Score 21 to 42	4	21.1%	0	0.0%	4	3.6%

Table 4 shows distribution of stroke patients according to the parameters of the A2DS2 score. All the parameters of A2DS2 score, Older age (>75), atrial fibrillation, dysphagia, male gender, and stroke severity were associated with increased risk for SAP in stroke patients, but among them Atrial fibrillation (p = 0.01), dysphagia (p = <0.01) and stroke severity according to NIHSS were statistically significant whereas age and male sex did not reach significance.

Table 4: Patients Distribution According To The Parameters Of A2DS2 Score

A2DS2 Score Parameters	Stroke With Pneumonia (N=19)		Stroke Without Pneumonia (N=91)		Total (N=110)		P-value
	N	%	N	%	N	%	
Age more than 75 years	5	26.3%	13	14.3%	18	16.4%	0.19
Atrial fibrillation	4	21.1%	4	4.4%	8	7.3%	0.01
Dysphagia	17	89.5%	23	25.3%	40	36.4%	<0.001
Male sex	13	68.4%	47	51.6%	60	54.5%	0.18
NIHSS score 0-4	0	0.0%	39	42.9%	39	35.5%	0.0004
NIHSS Score 5-15	12	63.2%	29	31.9%	36	32.7%	0.016
NIHSS Score >15	7	36.8%	23	25.3%	35	31.8%	0.3082

Table 5 shows Comparison of mean NIHSS mean A2DS2 score in patients with and without SAP. Overall mean A2DS2 score was 4.2 ± 2.4. Mean A2DS2 score was significantly higher among patients with the pneumonia (7.2 ± 3.5) than the patients without the pneumonia (2.1 ± 1.7) (P <0.0001). Mean NIHSS score was significantly higher among patients with SAP (14.7±6.8) than patients without SAP (8.5±6.7) (P <0.0001).

Table 5: Comparison Of Mean NIHSS Mean A2DS2 Score In Patients With And Without SAP

	Stroke With Pneumonia (N=19)	Stroke Without Pneumonia (N=91)	Total (N=110)	P-Value
A2DS2 score				
Mean	7.2	2.1	4.2	<0.0001
S.D.	3.5	1.7	2.4	
NIHSS score				
Mean	14.7	8.5	9.6	<0.0001
S.D.	6.8	6.7	6.7	

Table 6 shows correlation between SAP and Outcome of acute ischemic stroke patients. We observed that mortality was higher among acute ischemic stroke patients who developed SAP (15.8%) compared to patients who did not develop SAP (2.2%) (P=0.01).

Table 6: Correlation Between SAP And Outcome Of Acute Ischemic Stroke Patients

Outcome Of The Patients	Stroke With Pneumonia (N=19)		Stroke Without Pneumonia (N=91)		Total (N=110)		P-Value
	N	%	N	%	N	%	
Discharged	16	84.2%	89	97.8%	105	95.5%	0.01
Deceased	3	15.8%	2	2.2%	5	4.5%	
Mean duration of the hospitalization	15.2 ± 6.9 days		5.7 ± 2.2 days		7.4 ± 5.1 days		<0.0001

Table 7 shows Correlation between A2SD2 score and SAP. Patients with acute ischemic stroke who had high A2DS2 scores (5-10) at the time of presentation were at significantly higher risk of developing SAP compared to those who had low A2DS2 scores (0-4) (P <0.0001). Table 8 shows correlation between A2DS2 score and outcome of the stroke patients. All deceased patients had high A2DS2 scores on admission. Acute ischemic stroke patients who had high A2DS2 score on admission had higher mortality rates and lower discharge rates compared to patients who had low A2DS2 score who had better outcome (P = 0.026).

Table 7: Correlation Between A2SD2 Score And SAP

A2DS2 Score	Number Of Patients,(N=110)	Stroke With Pneumonia (N=19)		Stroke Without Pneumonia (N=91)	
		N	%	N	%
Low score (0-4) group	56	2	3.57	54	96.43
High score (5-10) group	54	17	31.48	37	68.52

Table 8: Correlation Between A2DS2 Score And Outcome Of Stroke Patients

Outcome	Low Score (0-4) Group (N=56)		High Score (5-10) Group (N=54)		Total (N=110)		P-Value
	N	%	N	%	N	%	
Discharged	56	53.3%	49	46.7%	105	100%	0.026*
Deceased	0	0.0%	5	100.0%	5	100%	
Mean duration of the hospitalization	5.01 ± 1.8 days		9.9 ± 6.2 days		7.4 ± 5.1 days		0.001

Discussion: This study was conducted at tertiary care center in Gujarat which included 110 patients presented with acute ischemic stroke. The proportion of male patients (54.5%) was higher than the female (45.5%) patients. The age ranged from 39 to 79 years, with more than half (53.7%) of the patients aged more than 60 years and nearly one fourth patients (25.5%) had age more than 69 years. Maximum number of patients were in age group 60 to 69 years (28.18%) followed by 50 to 59 years (27.27%). In study conducted by Vyas et al 56.4% patients were male while 42.4% patients were female.

The age ranged from 30 to 93 years. Maximum number of patients in their study were from age group of 51 to 60 years (28.8%) followed by 61 to 70 years (28.4%).

In the present study, the incidence of the SAP was 18.8%. A study conducted by Vyas et al at a tertiary care centre of Uttar Pradesh had a similar incidence of SAP (18.4%). It is also comparable to a study done by Li et al[8] (19%) but was much higher than that observed by Hoffmann et al 6 in Berlin (7.2%) and by Zhang et al[9] in China (7.3%).

Higher incidence of SAP in our study might be due to various reasons. First, the lack of specialized stroke unit care, an emerging concept of multidisciplinary approach with staff trained in strategies to prevent and be vigilant for complications after stroke, which is an ideal setting to manage stroke patients compared to routine wards. Second, the median NIHSS score was 6 in our study compared to 3 in study by Zhang et al[9]. Male gender was associated with higher incidence of SAP in our study, although not statistically significant. This can be due to higher prevalence of alcoholism and smoking among males. However, contrary to this, Vyas et al found non-significant but increased risk of SAP with female gender. Older age has been associated with higher risk of SAP in other studies[9,10]. In the present study, the incidence of SAP was maximum among the age group of 51 to 60 (26.7%), followed by the age group 60 to 70 years (19.4%) and age more than 70 years (17.9%). Study by Vyas et al observed the maximum incidence of the SAP in the age group of 41 to 50 years (22.9%) followed by age more than 70 years (22%), age 61 to 70 years (19.7%), 51 to 60 years (15.3%), and less than 40 years (5.6%). In our study, mean age of acute ischemic stroke patients with pneumonia (62.52±10.61) was higher than patients without pneumonia (59.94±9.19), it was statistically not significant.

Old age has been implicated as an independent risk factor for SAP in many previous studies as geriatric population have higher prevalence of other comorbidities as well as impaired swallowing[11].

According to one registry centre of India nearly 85% of the stroke patients had hypertension, half of them had diabetes mellitus, 26% had dyslipidaemia and 26.8% of men smoked tobacco[1]. In our study, Hypertension, diabetes mellitus, dyslipidemia, atrial fibrillation and previous history of stroke/ TIA was reported higher in acute ischemic stroke patients with SAP compared to patients without SAP while Ischemic heart disease was reported in higher proportion among patients without SAP than patients with SAP. However, none of these above

comorbidities reached statistical significance except atrial fibrillation (P = 0.02) and previous history of stroke/TIA (P = 0.0003). In a study conducted by Vyas et al atrial fibrillation was associated with increased risk for SAP while hypertensions, diabetes, ischemic heart disease, dyslipidemia, previous stroke were not associated with increased risk for SAP in stroke patients .

We observed significantly high incidence of SAP in patients with either newly diagnosed or old Atrial Fibrillation. AF is not only a well-known risk factor for complications in stroke patients such as SAP, but recently SAP has been established as an independent risk factor for hospital acquired pneumonia by Zhu et al[12]. Various underlying mechanisms have been proposed to explain this phenomenon, most importantly, increased pulmonary congestion due to decreased cardiac output and other hemodynamic changes in AF leads to increased risk of hospital acquired pneumonia. When this risk is combined with stroke induced immunosuppression, this may further multiply the risk of SAP in patients having AF with ischemic stroke.

In our study, incidence of SAP was statistically higher among patients who had history alcoholism (38.09%) compared to patients without alcohol consumption (12.36%) (P = 0.007). Patients with history of smoking also had higher incidence of SAP (22.5%) in comparison non-smokers (14.29%), but not statistically significant. Vyas et al noted that neither smoking nor alcohol consumption was associated with risk for SAP in stroke patients.

Presence of dysphagia at the time of admission was highly predictive of SAP in our study. Among all patients with acute ischemic stroke, dysphagia was present in 40 (36.36%) patients. Incidence of SAP was significantly higher in patients with dysphagia (42.5%) than patients without dysphagia (2.86%) (P<0.0001). In a study conducted by Vyas et al, 43% of patients had dysphagia and the incidence of pneumonia was significantly higher in the presence of dysphagia.

Similar study by Zhang et al had much lower incidence of SAP overall which might be since dysphagia screening was routinely performed in their department[90]. Patients having dysphagia are at an increased risk of silent aspiration and consequently pneumonia this has been validated by Abubakar et al showing that the odds for developing aspiration pneumonia is 13 times higher in patients having dysphagia[13]. Study by Finlayson et al also made evident that older age, male sex, and dysphagia were independent predictors of pneumonia [14].

Stroke severity as indicated by NIHSS is also a factor contributing to the risk of SAP[95]. We also observed significant association between NIHSS and the incidence of SAP. Among 19 patients with SAP, the score was more than 15 in 12 (63.2%) patients while it was 15 or less in 7 (36.8%) whereas among 91 patients without SAP, the score was more than 15 in 23 (25.3%) patients while it was 15 or less in 68 (74.8%) patients.

Mean NIHSS score was significantly higher among patients with SAP (14.7±6.8) than patients without SAP (8.5±6.7) (P <0.0001). Patients with higher NIHSS have larger infarcts, increased altered sensorium, dysphagia and thus are more prone to develop post-stroke complications including SAP.

Overall mean A2DS2 score was 4.2 ± 2.4 in our study which was significantly higher in patients who went on to develop SAP (7.2 ± 3.5) compared to patients who did not develop SAP (2.1 ± 1.7). In a study conducted by Vyas et al the mean A2DS2 score in patients with pneumonia was 7.02 ± 1.40, while it was 4.75 ± 1.92 in patients without pneumonia.

We also observed that dichotomizing stroke patients into low A2DS2 scores (0-4) and high A2DS2 scores (5-10) can be helpful in predicting SAP risk, as the incidence of SAP was significantly more in high A2DS2 score group (31.48%) in contrast to low A2DS2 score group (3.57%) (P <0.0001). In a study conducted by Li et al the incidence of SAP was 9.0% in patients with lower A2DS2 scores (0–4) whereas it was 65.0% in those with high A2DS2 scores. Similarly, Zhang et al also showed that higher A2DS2 score was associated with higher risk of SAP.

Stroke-associated pneumonia (SAP) is a predominant cause of post stroke morbidity and mortality[5,6]. Overall mortality was 5 (4.5%) in our study while 105 (95.5%) patients were discharged successfully. Mortality was much higher among patients with the pneumonia (15.8%) than patients without pneumonia (2.2%) (P = 0.01). The 28-day case fatality rate of stroke patients in Mumbai population-based survey [15] was 29.8%.

In Trivandrum stroke registry, the 28-day case fatality rate was 24.5% for urban and 37.1% for rural populations[16]. Further analysis demonstrated much higher fatality than our study in other Indian studies. The first 7-10 days of stroke, fatality occurs among 20% in Kerala and 33% in Kolkata[17]. In hospital pneumonia was associated with a worse prognosis. Among the patients in which pneumonia developed, 10.1% died in the hospital compared with 2.1% of those not so diagnosed in study conducted by Lakshminarayan et al[18].

In the present study, average days of hospital stay was 7.4±5.1 days which was higher among patients with pneumonia (15.2±6.9 days) than patients without pneumonia (5.7±2.2 days) (P <0.0001). Similarly, in a study conducted by Lakshminarayan et al median length of stay was 13 days (range, 3 to 118 days) in those diagnosed with pneumonia compared with 5 days (range, 3 to 99 days) in those without pneumonia.

We observed that A2DS2 score not only predicts the risk of SAP in stroke patients, but it can also be of utility as a predictor of in-hospital death in patients presenting with acute ischemic stroke.

Acute ischemic stroke patients who had high A2DS2 score on admission had higher mortality rates (9.2%) and lower discharge rates compared to patients who had low A2DS2 scores had better outcome (P = 0.026). All deceased patients had high A2DS2 scores while none of the patients with low A2DS2 scores died during hospital stay.

A hospital-based study conducted by Zhang et al reported overall mortality of 2.4% among the stroke patients. Mortality observed in their study was significantly higher among patients with high A2DS2 score (7.8%) than low A2DS2 score (1.2%).

Conclusion: In our study, most of the acute ischemic stroke patients with and without SAP were males, elderly, hypertensive and smoker.

Majority of patients who developed SAP had symptom of dysphagia and NIHSS score of 5 to 15 whereas most of the patients without SAP had commonest symptom of facial asymmetry and NIHSS score of 1 to 4. Patients in the high A2DS2 score group had higher incidence of SAP and non-favourable outcome compared to patients with low A2DS2 scores who had more favourable outcomes.

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