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Influence of location of paresis on site of pneumonia in stroke

Research Article

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Abstract: Introduction: Stroke can cause unilateral paresis of the diaphragm. It is, however, unknown if diaphragm paresis can lead to post-stroke pneumonias. We aimed to evaluate whether the location of post-stroke paresis influenced the location of pneumonia. Methods: This is a retrospective study of all patients admitted to stroke unit in 2006- 2009 with a diagnosis of acute ischemic stroke or intracerebral hemorrhage who had hemiparesis or hemiplegia, and who were diagnosed with unilateral pneumonia based on chest radiogram. Results: Of 1394 patients with a diagnosis of stroke, 64 (5%) patients met the study criteria. Of 35 patients with motor deficit on the left side, 18 (51%) developed pneumonia on the left and 17 (49%) on the right side (p=0.90). Of 29 patients with motor deficit on the right side, 17 (59%) developed pneumonia on the right and 12 (41 %) on the left side (p=0.51). Thus, of all 64 patients, 35 (55%) had pneumonia on the same side as the paresis and 29 (45%) on the contralateral side (p=0.60). Conclusions: There was no significant occurrence of pneumonia on the side of paresis. Therefore, the side of paresis is not likely to be a helpful clinical marker of diaphragm paresis.

Keywords: *Complications of stroke • Infection • Intensive care • Pneumonia • Stroke*

1. Introduction

Pneumonia is one of the most important complications of stroke. Pneumonia is responsible for poor clinical outcome [1], high mortality [2], delayed patient discharge from the hospital [3] and is one of the leading causes of hospital readmission [4]. Aspiration is considered to be the major cause of stroke-associated pneumonia because dysphagia was identified as its important risk factor [5].

An alternative causal explanation for stroke-associated pneumonia, however, may exist. Electromyography [6,7], transcranial magnetic stimulation [8,9], and ultrasonographic studies [10] have shown that diaphragm paresis may occur on the side affected by stroke. Hypothetically, hemidiaphragm paresis could lead to hypoventilation and cause pneumonia on the side affected by hemiparesis or hemiplegia.

There is renewed interest in understanding the role of diaphragm in the pathophysiology of post-stroke pneumonia. This is because novel therapeutic strategies could be used to prevent or treat post-stroke pneumonia. These strategies may include non-invasive ventilation, continuous positive airway pressure (CPAP), physiotherapy [11] or prophylactic antibiotics [12].

The goal of our pilot study was to assess whether the side of pneumonia was associated with the side of limb paresis as the simple clinical marker of diaphragm paresis.

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2. Materials and methods

This is a retrospective study of all patients hospitalized for stroke in the stroke unit at the Department of Neurology in St. Anne's University Hospital from 2006 to 2009. Our ethics committee approved the protocol. All hospital charts were reviewed and patients were included in the study if they were diagnosed with ischemic or hemorrhagic stroke, had hemiparesis or hemiplegia, developed unilateral pneumonia during hospitalization that was confirmed by chest radiogram. A radiologist blinded to clinical data reviewed all chest radiograms. All patients had to have an infarction or intracerebral hemorrhage documented on brain CT or MRI. Patients with bilateral pneumonia, negative radiological findings, monoparesis and quadruparesis were excluded.

In the studied group, demographic parameters, type of stroke, side of stroke, side of pneumonia, stroke risk factors, laboratory parameters and the need for orotracheal intubation, mechanical ventilation, and/or nasogastric tube during hospitalization were recorded. Stroke severity was assessed by the National Institutes of Health Stroke Scale (NIHSS) at baseline and modified Rankin Scale (mRS) at discharge.

2.1. Statistical analysis

Patients were considered in two groups: those who had pneumonia on the side of paresis and those who had pneumonia on the side contralateral to paresis. The statistical significance for inter-group differences was assessed by Chi-square. A level of $p \leq 0.05$ was selected for significance.

3. Results

Overall, 1394 patients diagnosed with ischemic or hemorrhagic stroke were admitted to the stroke unit from 2006 to 2009. Chest radiograms were available for 659 (47%) patients. The radiogram showed evidence of pneumonia in 72 (11%) patients. We excluded 3 patients without paresis, 4 patients with quadruparesis and 1 with monoparesis. The remaining 64 (5%) patients were selected for further analysis.

Patient characteristics are shown in Table 1. Thirty-four (53%) patients developed bronchopneumonia on the right side and 30 (47%) patients on the left side (p=0.72).

Table 1. Patient characteristics according to location of pneumonia relative to paresis.

	All patients	Ipsilateral Pneumonia	Contralateral Pneumonia	p
Number of patients	64	35	29	0.6
Age, mean±SD	73±11	73±12	72±10	0.66
Baseline NIHSS, median (interquartile range)	15 (8-19)	15 (8-17)	13 (7.5-20.5)	0.77
Glucose level, [mmol/l], mean±SD	7.58±2,35	7.5±2.65	7.7±1.9	0.8
CRP, [mg/l], mean±SD	98.94±76.8	92.5±69.5	106.7±82.9	0.47
White blood cells, [10E9/l], mean±SD	12.16±5.39	12.9±6.6	11.3±3	0.23
Creatinine, [umol/l], mean±SD	115±78	115±92	115±58	0.98
Male sex, n(%)	36 (56%)	21 (60%)	15 (52%)	0.48
Coronary heart disease, n(%)	35 (55%)	20 (57%)	15 (52%)	0.55
Atrial fibrillation, n(%)	26 (41%)	18 (51%)	8 (28%)	0.16
Arterial hypertension, n(%)	48 (75%)	29 (83%)	19 (66%)	0.3
Diabetes mellitus or impaired glucose tolerance, n(%)	22 (34%)	11 (31%)	11 (38%)	1
Hyperlipidemia, n(%)	20 (31%)	9 (26%)	11 (38%)	0.75
Cigarette smoking, n(%)	10 (16%)	8 (23%)	2 (7%)	0.16
COPD, n(%)	15 (23%)	7 (20%)	8 (28%)	0.86
Tracheostomy, n(%)	11 (17%)	3 (9%)	8 (28%)	0.27
Orotracheal intubation, n(%)	18 (28%)	10 (29%)	8 (28%)	0.74
Mechanical ventilation, n(%)	12 (19%)	6 (17%)	6 (21%)	1
Nasogastric tube, n(%)	36 (56%)	16 (46%)	20 (69%)	0.64
Supratentorial location, n(%)	59 (92%)	33 (94%)	26 (90%)	0.52
Cortical involvement, n(%)	39 (61%)	22 (63%)	17 (59%)	0.57

SD – standard deviation; NIHSS – National Institutes of Health Stroke Scale
CRP – C-reactive protein; COPD – chronic obstructive pulmonary disease

Of all 64 patients, 3 had community-acquired pneumonia and remaining 61 patients had nosocomial pneumonia. Aspiration was a cause of pneumonia in 4 cases. Three of the patients required artificial ventilation, one of whom subsequently died.

Of 35 patients with a motor deficit on the left side, 18 (51%) developed pneumonia on the left side and 17 (49%) on the right side (p=0.90). Of 29 patients with motor deficit on the right side, 17 (59%) developed pneumonia on the right side and 12 (41%) on the left side (p=0.51). Thus, of all 64 patients, 35 (55%) had pneumonia on the side of paresis and 29 (45%) on the side contralateral to paresis (p=0.60).

From the data available on readmission after discharge (available in 53 patients), 2 patients were readmitted for pneumonia and one for urinary tract infection.

4. Discussion

In our study, we were unable to demonstrate increased frequency of pneumonia on the side of the body with impaired motor functions due to stroke. Having the limb paresis as a marker of diaphragm paresis, our result suggests that there is no strong causal relationship between diaphragm paresis and pneumonia. Therefore, at patients observed, it is unlikely that weakness of the limb is associated with the hemi-diaphragm paresis that would cause pneumonia.

There are only few older studies considering stroke and pneumonia laterality and they present contradicting findings [13-15]. One study on 71 patients showed that incidence of pneumonia diagnosed by chest radiogram was 77% on the affected side by stroke [13]. Another study where pneumonia was diagnosed by necropsy showed that about half (6 of 11) of patients with unilateral pneumonia had pneumonia ipsilaterally to affected side [14].

In previous studies however, the paresis of a diaphragm was documented by chest radiographs [15,16], fluoroscopy [17] or ultrasound [10]. Studies using chest radiographs showed that after stroke, the diaphragm tended to be elevated ipsilaterally to stroke symptoms. Similarly, studies using fluoroscopy and ultrasonography showed that there could be altered diaphragmatic movement on the paretic side. However, the number of patients in these studies was small, with only 22 patients included in the fluoroscopy study and 8 in the ultrasonography study. In our study, due to its retrospective design, we could not document the presence of the diaphragm paresis. However, our intention was to investigate the potential of a simple clinical observation (presence of limb paresis) as a marker of the diaphragm paresis.

In our study, we screened substatial number of patients (n=1394). Interestingly, only 11% were diagnosed with pneumonia. This is a lower incidence than in previous studies which focus on complications after stroke (19-25%) [1,5,18,19]. The difference might be due to different study design or definitions for pneumonia (radiogram required and not required).

Our study had several limitations. The low number of patients limited the statistical power and prevented a stratified subanalysis of patients, for example, with respect to the severity of paresis. We did not exclude four patients with documented aspiration pneumonia, because of their small number, which did not affect the results. Also, we did not document the presence of diaphragm paresis; diaphragm paresis was hypothesized on the basis of paresis of limbs. However, it would be difficult to screen all the patients with electromyography (EMG) or ultrasound for the presence of diaphragm paresis. Compared to previous studies, we analyzed a large number of stroke patients and selected a very homogenous patient population, because pneumonia was confirmed by the independent reading of the chest radiogram.

In conclusion, our study found that the location of limb paresis does not influence the location of pneumonia, implying that the side of limb paresis is not likely to be an effective clinical marker of diaphragm paresis. Further studies that would prospectively document the relationship of diaphragm palsy and pneumonia on larger number of patients are needed.

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Conflict of interest

None.

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