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Research paper

Assessment of diabetes as a risk factor for neurogenic dysphagia confirmed by FEES examination in post-CVA patients

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Abstract

Introduction: Diabetes mellitus (DM) is an independent factor for the occurrence of neurogenic dysphagia following an acute cerebrovascular accident in the form of a stroke. This study assesses the role of DM as a risk factor for post-stroke dysphagia (PSD), confirmed by the fiberoptic endoscopic examination of swallowing (FEES) with particular emphasis on silent aspiration (SA) as a high risk factor of aspiration pneumonia (AP).

Aim: The aim of the study is to assess the role of DM as a risk factor for PSD.

Material and methods: Statistical analysis was performed on the cohort of 81 post-cerebrovascular-accident patients hospitalized in the neurological rehabilitation department. DM was diagnosed in more than one third of the cohort (35.8%). After the FEES examination, which was assessed in the penetration–aspiration scale (PAS), an analysis of DM incidence was performed in patients with diagnosed pharyngeal dysphagia of moderate degree (PAS 3–6) and severe degree (PAS 7–8).

Results and discussion: The incidence of DM in patients with moderate dysphagia was lower than in the cohort. The incidence of DM in patients with severe dysphagia (aspiration) was comparable to the percentage in the cohort. Although diabetes was twice as frequent among patients with aspiration than among those with mild dysphagia (24% vs. 12%), the odds ratio (OR) of the diabetes incidence in these groups was not statistically significant.

Conclusions: Although DM is an independent factor for PSD occurrence after cerebrovascular accident in the form of a stroke and a potential factor for lower cranial nerve neuropathy, no correlation between DM and PSD was found.

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1. INTRODUCTION

Diabetes is an independent factor for post-stroke dysphagia (PSD).[1] The PSD incidence following an acute stroke is estimated at 29%–81%.[2] PSD at the beginning of hospitalisation is an independent risk factor for death within a month of cerebrovascular accident CVA.[1] PSD occurs mainly following an ischaemic stroke.[1]

PSD considerably increases the risk of saliva and/or food aspiration into the respiratory tract, with consequent pulmonological complications, mainly aspiration pneumonia (AP).[3] PSD in an acute stroke period increases the risk of AP three-fold, whereas that of massive neurological deficit combined with aspiration increases the risk of AP eleven-fold.[3] AP is one of the major causes of death in an early post-CVA period and a negative prognostic factor for survival for 12 months following CVA.[4,5] The death risk for a patient with AP increases more than 6-fold compared to individuals without AP in an early CVA period and more than 3-fold within 12 months after CVA. The risk of severe disability in patients with AP in an early CVA period increases 3-fold within 12 months of CVA.[3] Other PSD consequences and complications include: malnutrition, dehydration, depressive disorders and social exclusion.[6] PSD is an independent factor for severe disability and death following a stroke.[7] Hence the importance of the correct diagnosis and proper determination of the PSD risk factors, including diabetes.

PSD diagnostics in stroke units are still based on screening tests, i.e. water swallowing test, which detects dysphagia with 37%–45% efficiency. The clinical tests efficiency is slightly higher (51%–55%) but only instrumental tests – video fluoroscopic swallowing study (VFSS) and fiberoptic endoscopic examination of swallowing (FEES) – ensure the highest PSD detectability (64%–80%).[1,8]

Diabetes *per se* increases the risk of dysphagia.[3,9] According to some authors, even as many as 50% of diabetics suffer from swallowing disorders.[10]

A potential coincidence of CVA and lower cranial nerve neuropathy is a separate issue, which is not dealt with in this study. It was rarely reported but it has not been analysed in correlation with PSD.[11–15]

There are no reports in the literature on a correlation between diabetes and moderate and severe PSD according to PAS.[16]

This study is the first attempt to evaluate diabetes as a risk factor for PSD confirmed with FEES with emphasis to silent aspiration (SA) as a high risk of AP.

2. AIM

The aim of the study is to assess the role of DM, both insulin-dependent and non-insulin-dependent, as a risk factor for PSD.

3. MATERIAL AND METHODS

The study group consisted of 81 patients hospitalised in the Department of Neurological Rehabilitation at the University Hospital in Olsztyn, Polanad. FEES was performed at the Department and Clinic of Otorhinolaryngology, Head and Neck Diseases at the University of Warmia and Mazury in Olsztyn in 2018–2020 as part of the project entitled 'Assessment of neurogenic dysphagia in patients in various phases of brain injury of vascular origin.' Diabetes (both insulin-dependent and non-insulin-dependent) was diagnosed during hospitalization at the stroke unit using standard methods: glycaemia measurements and HbA1c level.

A statistical analysis of data from 81 patients was performed involving 30 females (37.04 %) and 51 males (62.96 %). The median age in the study group was 64.5 years, and it was comparable among the females and the males (males 64.22 years, females 64.97 years). The age ranged from 23 to 91 years. Sixty-five patients (80.25 %) had suffered an ischaemic stroke, and 16 (19.75%) had suffered a haemorrhagic stroke, which corresponds to the incidence of ischaemic and haemorrhagic stroke incidence reported in the literature.[17]

After the relevant consent was obtained, each patient was examined by FEES with an assessment of food retention in the lower pharynx and possible food aspiration into the respiratory tract. The result of FEES was summarised on the 8-point PAS (Table 1). The FEES results assessed in the PAS as 1–2 points were classified as normal. The results assessed as 3–6 points in the PAS were classified as moderate dysphagia and assessed as 7–8 points in the PAS were classified as severe dysphagia (aspiration).

A statistical analysis was performed with the Statistica 12 program. The relationship between two factors was calculated with the χ^2 test or the χ^2 test with the Yates correction. The odds ratio (OR) was calculated to determine the strength of the relationship between two factors.

Table 1. Penetration–aspiration scale.[16]

Points	Description of PAS
1	Material does not reach the respiratory tract.
2	Material reaches the respiratory tract, remains above the vocal folds and is coughed up
3	Material reaches the respiratory tract, remains above the vocal folds and is not coughed up
4	Material reaches the respiratory tract, reaches the level of the vocal folds and is coughed up
5	Material reaches the respiratory tract, reaches the level of the vocal folds and is not coughed up
6	Material reaches the respiratory tract, goes below the level of the vocal folds and is coughed up to the higher level of the larynx or out of the respiratory tract
7	Material reaches the respiratory tract, goes below the level of the vocal folds and is not coughed up out of the trachea despite a considerable effort
8	Material reaches the respiratory tract, goes below the level of the vocal folds and no attemts at coughing it up are observed

4. RESULTS

Over one third (n = 29; 35.8%) of the cohort (n = 81) suffered from diabetes. In total, 20 patients had diagnosed non-insulin-dependent diabetes (24.69%), and 9 patients (11.11%) insulin-dependent diabetes (Figure 1).

The result of FEES and assessment on the PAS scale are presented in Figure 2.

FEES was normal (PAS 1) in 59 patients (72.84%). Seven patients (8.64%) were rated on PAS 2. Three patients (3.7%) were rated on PAS 3, and 2 patients (2.47%) were rated on PAS 4. Three patients (3.7%) were rated on PAS 5 – contact of solid food and pap with the vocal folds was observed in two of them, and contact of liquid – in 1 patient. Liquid was detected below the vocal folds, and its effective removal was observed in 1 patient (1.23%) – PAS 6. Food was found below the vocal folds in 6 patients (7.41%) without trying to remove it – PAS 8 (Figure 3).

The incidence of diabetes in patients with FEES-confirmed PSD (PAS 3–8, n = 15) was 33.33% (5 patients) and it was comparable with the percentage of diabetes in the cohort (35.8 %, n = 81). Two patients (22.2%) out of the group with moderate PSD (PAS 3–6, n = 9) were diagnosed diabetes – this percentage was lower than that in the cohort (35.8%) and it was not statistically significant (OR 0.48; 95% CI: 0.09; 2.46, P = 0.376, Figure 4).

The percentage of patients with diabetes in severe PSD – aspiration (PAS 7–8, n = 6) was 50% (3 patients) vs. 35.8% (n = 81) in the cohort and it was also statistically non-significant (OR 1.88; 95% CI: 0.35; 10.01; P = 0,457, Figure 5). Although diabetes was twice as frequent among patients with aspiration (PAS 7–8) than among those with moderate dysphagia (PAS 3–6; 50% vs. 22.22%), the odds ratio (OR) of the diabetes incidence in these groups was not statistically significant (OR 0.29; 95% CI: 0.03; 2.69; P = 0.274).

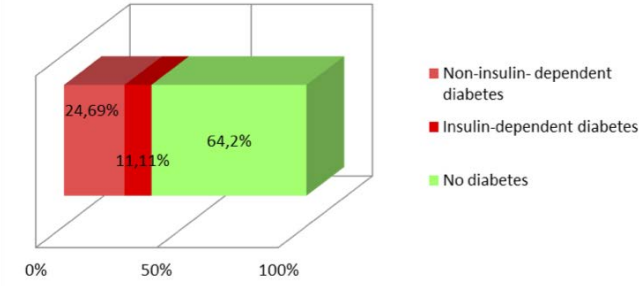

Figure 1. Percentage of diabetics in the cohort (n = 81).

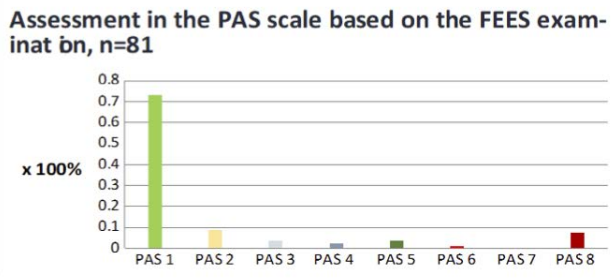

Figure 2. FEES – assessment in the Rosenbek scale, PAS (1–8 points), n = 81.

OR for the PSD incidence in the cohort was 0.88 (95% CI: 0.27; 2.86, P = 0.825) and was compared with the group with diagnosed diabetes and it was not statistically significant.

5. DISCUSSION

This study did not show a correlation between diabetes and PSD confirmed by FEES, although previous reports showed a positive correlation between the incidence of diabetes and oropharyngeal dysphagia[9,10,18] and between diabetes and PSD.[1,19,20] Most probably, this is due to the fact that FEES visualizes only the pharyngeal phase of swallowing, concerning the lower pharynx and omitting the oral phase. It results in a large quantitative limitation of patients with PSD confirmed FEES compared to the cohort (15 vs. 81 patients). Moreover,

Figure 3. Aspiration of food into the subglottic region and the lower respiratory tract.

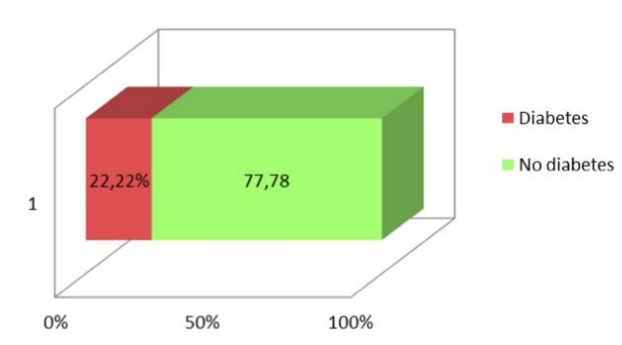

Figure 4. The percentage of diabetes in moderate dysphagia, PAS 3–6 (n = 9).

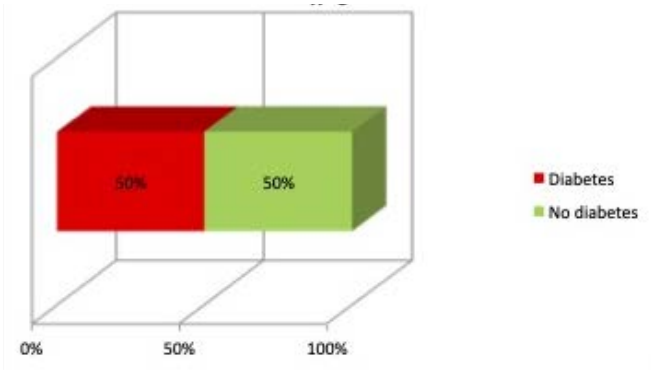

Figure 5. Percentage of diabetes in patients with aspiration, PAS 7–8, n = 6.

the FEES assessment was performed at the neurological rehabilitation department, which means that the earliest FEES was performed 10–14 days after CVA. As mentioned above, the few reports on PSD assessed by FEES concerned the first 72 h after CVA.[21,22] This issue certainly requires further studies on larger groups of patients as it concerns SA, which is very difficult to diagnose with the currently recommended screening methods.[2,23] The absence or weakening of the palatal or pharyngeal reflexes, which is observed quite frequently in PSD, can be one of the red flags helpful at the screening stage[1,17,24], however their pathophysiological background has not been clearly determined – whether this is an effect of the PSD-related diabetic neuropathy of the lower cranial nerves or rather an effect of the post-stroke damage on other levels of the central nervous system (CNS) taking part in the act of swallowing, i.e. afferent bulbo-cortical pathways, centres in the cerebral cortex, efferent cortico-bulbar pathways and the extrapyramidal system. It should not be forgotten that the weakening of the palatal and pharyngeal reflexes can be caused by other diseases concomitant with CVA, e.g. muscular, neuro-muscular junction diseases or sarcopenia.[25] Precise diagnostics of PSD, it's aetiology and co-morbidities which affect the severity of PSD is essential for the methods of PSD rehabilitation during the acute and chronic period after CVA like dietary recommendations, motor rehabilitation, various types of central and peripheral stimulation, feedback and its modifications, e. g. BiSSkiT (Biofeedback in Strength and Skill Training).[2,26–33]

6. CONCLUSIONS

Diabetes is not a predictor for moderate and severe PSD confirmed with FEES. This thesis requires further studies with a larger group of patients, as it concerns SA, associated with a high risk of AP, which in turn increases the risk of early disability and/or death of a PSD patients.

Conflict of interest
None declared.

Funding
None declared.

Ethics
The study was approved by the Bioethics Committee at the Faculty of Medicine of the University of Warmia and Mazury in Olsztyn (Resolution no 42/2019 of 25.04.2019).

References
1 Hamidon BB, Nabil I, Raymond AA. Risk factors and outcome of dysphagia after an acute ischaemic stroke. *Med J Malaysia*. 2006;61(5):553–557.

2 Dziewas R, Michou E, Trapl-Grundschober M, et al. European Stroke Organisation and European Society for Swallowing Disorders guideline for the diagnosis and treatment of post-stroke dysphagia. *Europ Stroke J Eur Stroke J*. 2021;6(3):89–115. https://doi.org/10.1177/23969873211039721.

3 Martino R, Foley N, Bhogal, Diamant N, Speechley M, Teasell R. Dysphagia after stroke: Incidence, diagnosis and pulmonary complications. *Stroke*.2005;36(12):2756–2763. https://doi.org/10.1161/01.str.0000190056.76543.eb.

4 Niewada M, Skowrońska M, Ryglewicz D, Kamiński B, Członkowska A. Acute ischaemic stroke care and outcome in centers participating in the Polish National Stroke Prevention and Treatment Registry. *Stroke*. 2006;37(7):1837–1843. https://doi.org/10.1161/01.str.0000226992.39847.ef.

5 Maeshima S, Osawa A, Hayashi T, Tanahashi N. Elderly age, bilateral lesions and severe neurological deficit are correlated with stroke-associated pneumonia. *J Stroke Cerebrovasc Dis*. 2014;23(3):484–489. https://doi.org/10.1016/j.jstrokecerebrovasdis.2013.04.004.

6 Crary MA, Humphrey JL, Carnaby-Mann G, Sambandam R, Miller L, Silliman S. Dysphagia, nutrition and hydration in ischemic stroke patients at admission and discharge from acute care. *Dysphagia*. 2013;28(1):69–76. https://doi.org/10.1007/s00455-012-9414-0.

7 Smithard DG, Smeeton NC, Wolfe CDA. Long-term outcome after stroke: Does dysphagia matter? *Age Ageing*. 2007;36(1):90–94. https://doi.org/10.1093/ageing/afl149.

8 Dziewas R, Warnecke T, Oelenberg S, et al. Towards a basic endoscopic assessment of swallowing in acute stroke – development and evaluation of a simple dysphagia. *Cerebrovasc Dis*. 2008;26(1):41–47. https://doi.org/10.1159/000135652.

9 Zakaria DA, Bekhet MM, Khodeir MS, Bassiouny SS, Saleh MM. Oropharyngeal Dysphagia and Diabetes Mellitus: Screening of 200 Type 1 and Type 2 Patients in Cairo. *Egypt. Folia Phoniatr Logop*. 2018;70(3–4):134–137. https://doi.org/10.1159/000491079.

10 Olszewski J, Zielińska-Bliźniewska H, Pietkiewicz P. Dysphagia as an interdisciplinary diagnostic and therapeutic problem. *Pol Otorhinolaryng Rev*. 2011; 11(suppl):44–49.

11 Sommer DD, Freeman JL. Bilateral vocal cord paralysis associated with diabetes mellitus: case reports. *J Otolaryngol*. 1994;23(3):169–171.

12 Semiz S, Fişenk F, Akçurin S, Bircan I. Temporary multiple cranial nerve palsies in a patient with type 1 diabetes mellitus. *Diabetes Metab*. 2002;28(5):413–416.

13 Savarimuthu MK, Nair AK. A case of Isolated Unilateral Glossopharyngeal Nerve Palsy. *Clin Med Res*. 2020;18(1):37–41. https://doi.org/10.3121%2Fcmr.2018.1452.

14 Kenmegne C, Jingi AM, Kamdem F, Choukem SP. Hypoglossal nerve paralysis revealing type 2 Diabetes Mellitus: a case report. *Reve Med Pharm*. 2016;6(2):617–621.

15 Joshi A, Sood V, Dua A, Dogra PM, Singh P, Shikha. Unilateral isolated hypoglossal nerve palsy: A rare complication of Diabetes Mellitus. *Int J Neurol Res*. 2019;1(1):1–2.

16 Rosenbek JC, Robbins JA, Roecker EB, Coyle JL, Wood JL. A penetration-aspiration scale. *Dysphagia*. 1996;11(2):93–98. https://doi.org/10.1007/bf00417897.

17 Błażejewska-Hyżorek B, Czernuszenko A, Członkowska A. Guidelines for the management of stroke. *Pol Przegl Neurol*. 2019;15(suppl A):1–156. https://doi.org/10.5603/PPN.2019.0001.

18 López-Ornelas L, Bollain-Goytia IS, Macías-Valle LF, Morales-Cadena M, Rivas Mercado A. Swallowing disorder as finding in adult patients with diabetes mellitus type 2. *An Orl Mex*. 2015;60(2):103–108.

19 Khedr EM, Abbass MA, Soliman RK, Zaki AF, Gamea A. Post-stroke dysphagia: frequency, risk factors and topographic representation: hospital-based study. *Egypt J Neurol Psychiatry Neurosurg*. 2021;57:23. https://doi.org/10.1186/s41983-021-00281-9.

20 Yang C, Pan Y. Risk factors of dysphagia in patients with ischemic stroke: A meta-analysis and systematic review. *PLoS One*. 2022;17(6):e0270096. https://doi.org/10.1371/journal.pone.0270096.

21 Warnecke T, Teismann I, Oelenberg S, et al. The safety of fiberoptic endoscopic evaluation of swallowing in acute stroke patients. *Stroke*. 2009;40(2):482–486. https://doi.org/10.1161/strokeaha.108.520775.

22 Ickenstein GW, Höhlig C, Prosiegel M, et al. Prediction of outcome in neurogenic oropharyngeal dysphagia within 72 hours of acute stroke. *J Stroke Cerebrovasc Dis*. 2012;21(7):569–576. https://doi.org/10.1016/j.jstrokecerebrovasdis.2011.01.004.

23 Arnold M, Liesirova K, Broeg-Morvay A, et al. Dysphagia in acute stroke: incidence, burden and impact on clinical outcome. *PLoS One*. 2016;11(2):e0148424. https://doi.org/10.1371/journal.pone.0148424.

24 Steinhagen V, Grossmann A, Benecke R, Walter U. Swallowing disturbance pattern relates to brain lesion location in acute stroke patients. *Stroke*. 2009;40(5):1903–1906. https://doi.org/10.1161/strokeaha.108.535468.

25 Sheth N, Diner WC. Swallowing problems in the elderly. *Dysphagia*. 1998;2:209–215. https://doi.org/10.1007/BF02414428.

26 Hamzic S, Schramm P, Khiland H, Gerriets T, Juenemann M. Isolated dysphagia in a patient with medial medullary infarction – effects of evidence-based therapy. *Case Rep Neurol*. 2021;13(1):190–199. https://doi.org/10.1159/000513676.

27 Langmore SE, Pisegna JM. Efficacy of exercises to rehabilitate dysphagia: a critique of the literature. *Int J Speech Lang Pathol*. 2015;17(3):222–229. https://doi.org/10.3109/17549507.2015.1024171.

28 Grigus I, Romanyshyn M. Clinical review of physical therapy intervention of swallowing disorder after stroke. *J Health Sci*. 2013;3(1):87–96.

29 Jones CA, Colletti CM, Ding MC. Post-stroke dysphagia: recent insights and unanswered questions. *Curr Neurol Neurosci Rep*. 2020;20(12):61. https://doi.org/10.1007%2Fs11910-020-01081-z.

30 Dziewas R, Stellato R, van der Tweel I, et al. Pharyngeal electrical stimulation for early decannulation in tracheotomised patients with neurogenic dysphagia after stroke (PHAST-TRAC): a prospective, single-blinded, randomised trial. *Lancet Neurol*. 2018;17(10):849–859. https://doi.org/10.1016/s1474-4422(18)30255-2.

31 Chen YW, Chang KH, Chen HC, Liang WM, Wang YH, Lin YN. The effects of surface neuromuscular electrical stimulation on poststroke dysphagia: a systemic review and metaanalysis. *Clin Rehabil*. 2016;30(1):24–35. https://doi.org/10.1177/0269215515571681.

32 Zhang C, Zheng X, Lu R, Yun W, Yun H, Zhou X. Repetitive transcranial magnetic stimulation in combination with neuromuscular electrical stimulation for treatment of poststroke dysphagia. *J Int Med Res*. 2019;47(2):662–672. https://doi.org/10.1177/0300060518807340.

33 Li Y, Feng H, Li J, Wang H, Chen N, Yang J. The effect of transcranial direct current stimulation of pharyngeal motor cortex on swallowing function in patients with chronic dysphagia after stroke: a retrospective cohort study. *Medicine (Baltimore)*. 2020;99(10):e19121. https://doi.org/10.1097/md.0000000000019121.

34 Park JS, Hwang NK, Kim HH, Lee G, Jung YJ. Effect of neuromuscular electrical stimulation combined with effortful swallowing using electromyographic biofeedback on oropharyngeal swallowing function in stroke patients with dysphagia: a pilot study. *Medicine (Baltimore)*. 2019;98(44):e17702. https://doi.org/10.1097/md.0000000000017702.